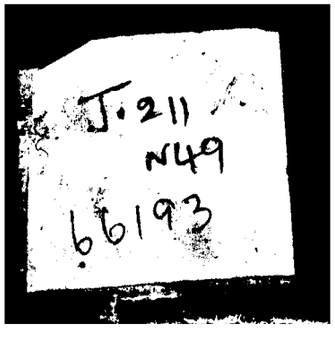

AGRICULTURAL ASSISTANT SECRETARY
22 OCT 1953
FOOD AND AGRICULTURE DEPT.


31


J.211
N49
66193

LEAFLET—No. 1. 50,002—28-3-49.

MADRAS AGRICULTURAL DEPARTMENT.

GROW MORE FODDER TREES.

Cattle are the back bone of our agriculture and as such much care has to be taken for their upkeep. They have to be fed properly if they have to be really useful to the agriculturist. But most of our animals are poorly fed and often depend upon stray clumps of grasses here and there. While the straw of cereal crops like paddy and cholam (Jonna) are generally fed to animals, regular fodder crops are also raised by wise provident ryots to get enough fodder for their cattle. In tracts with the famous breeds of cattle as Kangayam, Ongole, Alambadi, etc., the success of breeding is to a great extent due to the care taken in feeding the animals.

During severe drought periods, the problem of providing fodder for cattle is often very difficult and it is a common practice for ryots to sell their cattle at very low prices. When considering the fodder problem, we have to look to means by which shortage in fodders can be met with at such periods; growing of trees which will be useful for fodder will to a great extent alleviate the condition in our Province where rainfall is precarious and especially in Central and Southern districts.

The importance of trees in a tropical country like ours is quite well realized by everybody. They afford shade during the hot season and are useful to the agriculturist in many ways as yielding green leaf for manure, standing as wind break and protecting his delicate crops like cane or banana, affording shade to crops in tea and coffee plantations, providing fuel and timber for his agriculture and household needs and yielding fodder for his cattle. Though a particular species may not serve all the above purposes, very often they are useful to man in more than one way. There are a large number of trees which yield leaves that are readily eaten by animals and as such they can be grown with advantage. Besides the leaves, other parts as young shoots and pods are also useful as feed.

A list of fodder trees is given hereunder with names of local languages and short notes about their propagation, growth habits, etc. Suitable trees for the locality may be selected and grown in all waste places as porombokes, roadsides and manure pits. They have to be protected from the animals till they reach suitable heights and nursed with care. Even when they are fully grown, the lopping of the branches has to be done judiciously to avoid drying of the whole tree due to severe pruning.

Most of the trees mentioned in the list are raised from seeds. Whenever they can be propagated by cuttings it is mentioned under the particular species. Seedlings are to be raised in advance preferably in small pots or bamboo tubes and transplanted during the rainy season.

(1) *Acacia arabia*, Wild. (Leguminosæ).

Tam. Karuvelam; *Tel.* Nalla thumma; *Mal.* Karuvelam; *Kan.* Kaihali

A tree well adapted for dry climate and heavy soils. The pods are eaten by sheep and goats; the leaves and tender shoots are also eaten. The tree is valued for fuel and the bark is also used in tanning.

(2) *Acacia leucophloea*, Wild. (Leguminosæ).

Tam. Velvelam; *Tel.* Tella thumma; *Mal.* Velvelam; *Kan.* Nayivela.

Suited for dry localities and under even rocky conditions. Fairly quick growing if protected in the earlier stages from animals. The leaves and tender shoots are eaten by sheep and goats; the pods are relished by cattle. In summer months they serve more as concentrates to Kangayam animals in that tract.

DEPARTMENT OF AGRICULTURE, MADRAS.

Leaflets - New Series.

No.

1. Grow More Fodder Trees.
2. A Note on Cashew Cultivation.
6. Canning of Mangoes.
7. Bellary Onion (Allium Cepa).
8. Brinjal (Solanum melongenum).
9. Jams, Jellies and Marmalades.
10. Utilization of Ca shew Apples.
11. Coconut Cultivation.
12. A Short Note on Potato Cultivation.
16. Some Quick Growing Fuel Trees.
17. Some Avenue Trees.
18. Hill Fruits.
19. Fruit Trees of the Plains.
20. Green-Leaf Manure Yielding Plants & Trees.

Leaflets - Unnumbered.

Bendai (Hibiscus Esculentus).
Cucumber (Cucumis sativus).
Economics of Fruit Preservation as a Cottage Industry.
Green Manuring of Paddy.
Fruit Juices, Squashes and Cordials.
Paddy Manuring in Madras Presidency.
Preparation of Compost Manure from Town Waste.
Results of Manurial Trials in Madras.
The San Jose Scale (Quadraspidiotus Perniciosus (Comst.) in the Nilgiris.
Tomato (Lycopersicum esculentum).
Vegetable Culture in Boxes. (New Technique outlined for City Dwellers who lack Suitable Backyards).

(3) *Aegle marmelos*, Corr. (Rutaceae).

Tam. Vilva; *Tel.* Maredu; *Mal.* Kovalam.

This also comes up under dry conditions and can be easily raised in waste places. The fruits are valued medicinally. The young shoots and leaves are eaten by sheep, goats and cattle.

(4) *Albizzia amara* Boiv. (Leguminosae).

Tam. Usil; Unjal; *Tel.* Chigiruchettu; *Mal.* Varacchi; *Kan.* Sijjalu.

(5) *Albizzia lebbeck*, Benth. (Leguminosae).

Tam. Vagai; *Tel.* Dirasana; *Mal.* Vaka; *Kan.* Bage.

Both the above species come up well under dry conditions with a little care. The leaves form a good fodder for cattle, sheep and goats.

6. *Anogeissus latifolia*, Wall. (Combretaceæ).

Tam. Vella Nagai; *Tel.* Chiriman; *Mal.* Vella Nava.

A large tree which comes up well in plains and up to 4,000 feet. The wood is hard and valuable for timber and agricultural implements. The leaves form a good fodder.

(7) *Artocarpus integrifolia*, Linn, (Moraceæ).

Tam. Pila; *Tel.* Panasa; *Mal.* Pilavi; *Kan.* Alasu.

Best suited for west coast districts. A large ever-green tree. Wood useful in many purposes; ripe fruits and young fruits much useful as desert and vegetable respectively. The leaves are much relished by animals.

(8) *Bauhinia malabarica*, Roxb. (Leguminosae).

Tam. Malaganthi; *Tel.* Pulichinta; *Mal.* Mandaram; *Kan.* Kudugulu.

(9) *Bauhinia purpurea*, Linn. (Leguminosae).

Tam. Mandari; *Tel.* Kanchanam; Bondanta chettu.

With a little care and watering, comes up well and can be planted as an ornamental avenue tree also. The leaves are eaten by cattle, sheep and goats.

(10) *Bauhinia variegata*, Linn.

Tam. Segapu-manchori; *Tel.* Mandarai, Bodantham.

Comes up well under dry conditions and grown as an ornamental tree. The young leaves and flower buds can be used as vegetable. The leaves are much relished by cattle, sheep and goats.

(11) *Bassia latifolia*, Roxb. (Sapotaceae).

Tam. Illupei; *Tel.* Ippa; *Mal.* Ilupa; *Kan.* Ippi.

A large handsome tree which comes up well under all conditions except in too hot and too chill climate. The seeds yield a valuable oil for burning; the flowers which contain much sugar is used as food and also for the distillation of spirit. The leaves, flowers and fruits are eaten by cattle, sheep and goats.

(12) *Bridelia retusa*, Spr. (Euphorbiaceae).

Tam. Mulvengai; *Tel.* Koramanu; *Mal.* Mulluvenga; *Kan.* Komanji.

The species is useful both for fuel and fodder. Grows to a small or moderate sized tree.

(13) *Butea frondosa*, Koen. (Leguminosae).

Tam. Porasu. *Tel.* Moduga; *Mal.* Plass; *Kan.* Muthuga.

Comes up well in heavy soils and in black cotton soils. The leaflets are large and used to serve as plates for taking food, also forms fodder for cattle, sheep and goats.

(14) *Cassia fistula*, Linn. (Leguminosae).

Tam. Konnei; *Tel.* Rela; *Mal.* Konna; *Kan.* Kakke.

Can be grown in all places in the plains. Wood is hard and durable; the trees may be planted along avenues. Cattle, sheep and goats relish the leaves.

(15) *Cassia siamea*, Lank. (Leguminosae).

Tam. Manja Konnei; Simaiavarai; *Tel.* Sematangedu; Mal. Manna Konna; *Kan.* Hiretangedu.

A very quick growing tree coming up well in all places in the plains; suited for dry localities. Trees may be used as fuel. The leaves are fed by animals.

(16) *Enterolobium saman*, Prain. (Leguminosae).

Tam. Thungumoonji; *Tel.* Nidraganneru.

Another quick growing tree, producing plenty of foliage. Thrives well in places with moderate rainfall. Leaves form good fodder.

(17) *Erythrina indica*, Lam. (Leguminosae).

Tam. Kalyana murungai; *Mal.* Murungai; *Tel.* Baditha; *Mal.* Murukku *Kan.* Haliiana, Warjipa.

Suited for all conditions on plains. The leaves are very valuable for milch cattle. Can be propagated by cuttings also.

(18) *Feronia elephantum*, Corr. (Rutaceae).

Tam. Vila vilatti; *Tel.* Velaga; *Mal.* Vila; *Kan.* Bilva.

A very large tree coming up well in dry localities. The pulp of the fruit is much eaten. The leaves are eaten by sheep and goats.

(19) *Ficus bengalensis*, Linn. (Moraceae).

Tam. Alamaram; *Tel.* Marri; *Mel.* Ala; *Kan.* Alada.

A very large tree which can be grown along roadsides under all conditions on plains. The leaves are much relished by goats and also by sheep and cattle. Can be easily raised from cuttings.

(20) *Ficus glomerata*, Roxb. (Moraceae).

Tam. Atthi; *Tel.* Atthi; *Mal.* Athi; *Kan.* Atti.

(21) *Ficus infectoria*, Roxb. (Moraceae).

Tam. Malai-ichchi; *Tel.* Jatijuvi; *Mal.* Cherla; *Kan.* Basari.

(22) *Ficus retusa*, Linn. (Moraceae).

Tam. Pou-ichchi; *Tel.* Konda juvi; *Mal.* Ittiyal; *Kan.* Pilala.

(23) *Ficus tsiela*, Roxb.

Tam. Kal-ichchi; *Tel.* Pedda-juvi; *Mal.* Kirgali; *Kan.* Billibasara.

The above four species of Ficus can be grown in all districts on the plains, preferably as avenue or shade trees. They are easily raised by cuttings also. The leaves and the very young shoots are eaten by cattle, sheep and goats.

(24) *Ficus religiosa*, Linn. (Moraceae).

Tam. Arasu; *Tel.* Ravi chettu; *Mal.* Arasu; *Kan.* Aroli, Aswatham.

A very large tree, often treated as sacred and can be grown under all climatic conditions except on hills. Can be grown near village chavadis, temples and road sides. The leaves are valuable fodder. Can be raised by cuttings also.

(25) *Grewia subinaequalis*, DC. (Tiliaceae).

Tam. Palica; *Tel.* Jana; *Kan.* Buttiyadipe.

Requires fairly good rainfall and alluvial soil. Wood is used as timber. Fruits are edible and branches can be lopped for fodder.

a few handfuls of ash and well rotted cattle manure or leaf mould. Seeds are generally sown direct in the pits at the beginning of the monsoon after one or two soaking rains. Two nuts may be sown in each pit to allow for bad germination or pulling out of unthrifty seedlings in the later stages. It may be necessary to protect the young germinating seedlings from the depredations of birds and jackals that have a great liking for the fleshy and delicious cotyledons, by surrounding them with some thorns or other devices.

The practice of raising a nursery and transplanting of healthy selected seedlings about a month or two old is also adopted in certain localities. The nursery is conveniently raised in elevated beds or preferably in baskets filled with good soil. The latter method enables transplantation being done at required distance without great disturbance to the roots. Planting of seedlings is generally done during rains. A little watering and shading of the seedlings may be necessary till they get established, if the days happen to be rather hot.

The whole plantation may be laid out into convenient plots with bunds to facilitate soaking in of rains and to prevent surface wash. Some catch crops can also be taken for the first few years if the soil and local conditions permit. This would provide some subsidiary income and also benefit the plantation indirectly.

Harvesting.—If the plantation receives good attention right up from the selection of seed onwards, the trees may be expected to yield in the third or fourth year and fairly heavy crops can be obtained from the eighth year. Flowers appear from about November and the fruits ripen by February-March and continue to yield till May. The harvest of ripe fruits is done periodically and the exposed nuts removed from the fleshy swollen pedicles or ' apples ' as they are commonly called. If the ripe fruits are allowed to remain on the trees, bats carry away whole fruits with nuts during nights. Birds and squirrels also do some damage to the ripe fruit but the nuts are generally dropped on the ground from where they can be picked daily. The yields vary and on an average about

8 annas worth of nuts per annum may be expected from a tree. The nuts are generally marketed as such or sold as roasted kernels. There is also a market for the unroasted raw kernels. In some places immature kernels from the green nuts are also in demand for making curries.

Curing.—The curing of cashewnuts includes such processes as roasting, shelling, peeling, sweating and finally grading and packing. The nuts are generally roasted in shallow open pans of convenient size over ordinary mud furnaces. Great precaution is taken to stir the nuts properly to ensure uniform and correct roasting as otherwise the nuts would get charred and finally result, while shelling, in a large percentage of over-roasted and split kernels. The nuts are then taken out of the pan and spread on the floor and allowed to cool. They are often sprinkled over with ash or paddy husk to remove the exuding caustic oil. The roasted kernels are handshelled by women, care being taken to recover as many of whole kernels as possible. The proportion of kernels to whole nuts that may be obtained is about 25 to 30 per cent. The roasted kernels are again dried properly to facilitate the peeling off of the outer skin. The kernels are slightly moistened or " sweated " again to prevent breaking in transit. They are finally graded, packed in hermetically sealed containers and marketed.

Marketing.—The nuts are largely exported after curing, in the form of roasted kernels and there are large number of curing centres which buy raw nuts. The chief centres of curing are Mangalore, and Rajahmundry in Madras and Alwaye and Quilon in Travancore State. There is also some trade at other minor centres like Tanjore, Panruti and Cuddalore where chiefly the unroasted kernels are marketed. The present supply of local nuts is just sufficient to engage the hands at curing centres for about seven months in the year, and lakhs of rupees worth of nuts are annually imported from East Africa to provide work for the rest of the year. European markets are still untouched and there is likely to be a good demand

After Cultivation.—The crop requires frequent irrigations in the absence of rains. The 'life' irrigation is given about 4 days after planting and later irrigations at intervals of 8 to 10 days. Weeding must be thorough, as the presence of weeds reduces the yield considerably. Deep inter-cultivation should be avoided, as it damages the feeding roots

(26) *Hardwickia binata*, Roxb. (Leguminosæ).

Tam. Acha; Kattudugu; *Tel.* Yepi; *Mal.* Acha; *Kan.* Kamra.

Comes up well in dry localities and grows to a large tree. Wood is useful as timber and for agricultural implements. The leaves are eaten by cattle, sheep and goats.

(27) *Pithecolobium dulce*, Benth. (Leguminosæ).

Tam. Kodukkappuli; *Tel.* Simachintha; *Kan.* Sinchunise.

Suited for dry conditions and can be grown along hedges. Quick growing; the aril on the seeds edible. The pods are eaten by cattle, the tender shoots and leaves by goats.

(28) *Prosopis juliflora*, DC. (Leguminosæ).

This is a tree introduced from America where the pods are valued as cattle feed and said to be ' as nutritious as corn '. It is quick growing and highly drought resistant. The leaves, young shoots and pods are useful for cattle.

(29) *Pterocarpus marsupium*, Roxb. (Leguminosæ).

Tam. Vengai; *Tel.* Yegi; *Mal.* Venga; *Kan.* Honne.

Can be grown in all districts. Grows to a large tree; the timber is much useful and a gum called ' Kino ' useful in medicine is obtained from this tree. Cattle, sheep and goats relish the leaves.

(30) *Sesbania grandiflora*, Pers. (Leguminosæ).

Tam. Agathi; *Tel.* Avesi; *Mal.* Akatti; *Kan.* Agase.

Requires copious watering and can be grown in the back yards, along field bunds and irrigation channels. The leaves are much useful as vegetable. The young shoots and leaves are greatly relished by cattle. A very quick growing tree and can be used as fuel also.

(31) *Terminalia bellerica*, Roxb. (Combretaceæ).

Tam. Thani; *Tel.* Tani; *Mal.* Thani.

A large tree which can be grown in all districts on the plains. The leaves are eaten by cattle, sheep and goats.

(32) *Zizyphus jujuba*, Lam. (Rhamnaceæ).

Tam. Elandai; *Tel.* Regu; Rengha; *Mal.* Cherumali; *Kan.* Yelchi Bore.

Suited for all dry localities. A low thorny tree, the fruits of which are edible. The leaves are relished by sheep and goats.

S. N. CHANDRASEKARAN,
Lecturing and Systematic Botanist, Agricultural College and Research Institute.

LAWLEY ROAD P.O.
COIMBATORE.

Leaflet No. 2.

DEPARTMENT OF AGRICULTURE, MADRAS

A Note on Cashew Cultivation

The cashew (*Anacardium occidentale, L.*) originally introduced into the coastal tracts of India from South America by the Portuguese is becoming increasingly popular in the Madras Presidency on account of its very palatable and commercially important kernels. Being a hardy tree it is capable of thriving under varied conditions of soil and climate. Its cultivation has of late spread from the coastal districts to the interior tracts of the Presidency. In the West Coast districts and the States of Travancore and Cochin it is cultivated largely in the laterite and sandy waste lands both for its nuts and fuel. In recent years the demand for cashewnuts has increased markedly and it is considered worthwhile paying better attention to its cultivation and to explore the possibility of extending its area particularly in lands which are unsuited to other crops.

Selection of seed.—There are several varieties of cashew differing in growth-habit, yielding capacities, colour and shape of fruits, and size and shape of nut. The number of nuts per pound may vary from about 50 to 150. Seed nuts are generally selected from healthy and regularly bearing, high yielding bushy types of trees. Plumpy, well shaped, medium sized, heavy nuts obtained from fully ripe fruits are considered the best for seed purposes.

Planting.—The cashew comes up well in a variety of soils ranging from the red gravelly to the sandy type and requires neither manuring nor much cultivation. It also thrives under a wide range of rainfall—from about 30 inches to over 150 inches. For sowing, pits of 1 foot or 1½ feet cube may be previously dug 20 feet apart both ways and refilled to about three-fourths with good surface soil. If the soil happens to be too poor it is customary to mix with it

After Cultivation.—The crop requires frequent irrigations in the absence of rains. The 'life' irrigation is given about 4 days after planting and later irrigations at intervals of 8 to 10 days. Weeding must be thorough, as the presence of weeds reduces the yield considerably. Deep inter-cultivation should be avoided, as it damages the feeding roots

from these quarters as well. A fairly good quantity of cashew kernels is also consumed in the local markets and it can easily be doubled by better and more organized methods of marketing.

Uses.—Apart from the cashew kernels which are very popular and utilized to the largest extent, the cashew yields other products of marked value. The kernels are very nutritious as they are said to contain Vitamins A and B-2 and are also considered a good source of protein. There is large demand for the kernels overseas particularly from America where they are largely used for confectionary and for table purposes as salted nuts. Broken tips of kernels and seed coat obtained from processing, form very good feed for fowls and pigs. The cashewnut shell gives an oil which is a good preservative against termites. The shell charcoal is considered good for fuel. The apple is edible and the juice obtained from it on fermentation may be converted either into vinegar or alcohol. The tree gives timber of some value and yields fairly good quality firewood and charcoal. A resinous gum which is said to be an insect deterrent and suitable for book-binding is also obtained by making incisions on the bark of the tree.

Officers of the Agricultural Department will be ready to help anyone interested in starting cashew plantations with advice or by way of supplying good selected seed.

C. M. JOHN,
Oil-seeds Specialist.

MADRAS: PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS.

Leaflet No. 6.

CANNING OF MANGOES.

In recent years, the fruit canning industry has expanded rapidly in several parts of the world. Most of the research work done on the subject in America and in England is concerned chiefly with fruits like peaches, apricots, pears, plums, etc., which are peculiar to those regions. In India, however, the most important fruits are the tropical fruits like mangoes, pineapples, guavas, etc. Very little work has been done regarding the preservation of these fruits. Of these, the mango is the most important commercial fruit all over India. It is only in India that some of the best varieties are found. In the Madras Presidency, a large number of varieties of excellent quality are grown. Experiments carried out at the Fruit Products Research Laboratory, Kodur, during the past three years have shown that some of these varieties are highly suited for canning and that the canned product is of excellent quality. Varieties like Baneshan, Neelum and Mulgoa, with their crisp and non-fibrous flesh and good taste and flavour, stand the canning processes remarkably well. Soft and juicy varieties like the 'Rasams' of Circars, are not suitable for canning as they break down during canning and make the covering syrup cloudy and unattractive. The method of canning is briefly as follows:—

Fully ripe, but firm, fruit is taken, washed well in water and peeled by means of a stainless knife by working it round the fruit so that the peel is lifted in one long strip. The two sides are then sliced off and each slice is cut into two halves. The flesh on the thin side of the stone is removed in two sections. Thus from each fruit, six longitudinal slices of approximately equal size are obtained. These are placed inside an open top can of A 2½ size. The can may be either the plain one or the fruit-lacquered one.

to 15 inches apart with the help of the country plough.

Manuring.—Onion responds to fertilizers. A basal dressing of 15 to 20 cartloads of farm-yard manure may be applied before plantings. A top-dressing of 800 lb. of groundnut cake meal and 130 lb. of ammonium phosphate per acre applied in two instalments, once at the time of transplanting and again after about 50 days has been found to be effective in enhancing the yield.

Transplanting.—Seedlings are planted on both sides of the ridges with a spacing of 3 to 4 inches. It is advisable to water the nursery just before lifting the seedlings. The field is given a soaking irrigation before transplanting. While transplanting, it is a good practice to reject all poorly developed seedlings and care must be taken to avoid deep planting as it results in under-sized bulbs. The optimum depth of planting is between 1 and 1½ inches.

After Cultivation.—The crop requires frequent irrigations in the absence of rains. The 'life' irrigation is given about 4 days after planting and later irrigations at intervals of 8 to 10 days. Weeding must be thorough, as the presence of weeds reduces the yield considerably. Deep inter-cultivation should be avoided, as it damages the feeding roots.

The cans are made of tin plate of special quality which is generally coated with fruit lacquer which is resistant to the action of water soluble pigments of the fruit. The fruit slices are packed tight inside the can and covered with sugar syrup of 40 deg. Brix at 175–180°F, leaving a headspace of about ¼ of an inch. The cans are then exhausted by placing them in hot water at 185-190°F for ten minutes. The object of this process is to remove the oxygen from the tissues of the fruit which would otherwise lead to discoloration and spoilage of the fruit during subsequent storage. The cans are then sealed hermetically by means of a special closing machine known as a 'double-seamer'. American seaming machine like 'Burpee sealer' or 'Dixie automatic sealer' are very handy for home canning. The sealed can is 'cooked' or 'processed' in boiling water for 30 minutes and then cooled quickly in cold water to prevent 'over-cooking' and 'stack-burning' during storage. When the cans have cooled to about 110°F, they are wiped dry, labelled and stored for use later. If the processes are carried out properly, the finished canned product keeps well for one to two years. Thus, canning affords a safe and ready means of storing the richness of the summer fruit at its best for other lean months of the year.

Methods have been worked out for canning other fruits like guava, pineapple, grape fruit, etc. Those who are interested are welcome to visit the Fruit Products Research Laboratory at Kodur, Cuddapah district. Information regarding fruit canning can be had from the Biochemist, Kodur P.O., who is the Officer in charge of fruit preservation work.

G. S. SIDDAPPA,
Biochemist.

GOVT. PRESS, MADRAS.

[redacted]DRAS: PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS.

Bellary Onion (*Allium Cepa*).

Introduction.—Bellary onion is an important market garden crop and occupies a prominent place as an article of culinary use in any Indian household. It is chiefly a cool-season crop requiring plenty of moisture in the early stages of growth and a dry climate at the time of harvest. Its name is derived from the Bellary district where it is grown on an extensive scale and the crop has now spread to many of the other elevated districts in the Province.

Season.—There are two main seasons for this crop. The first is the monsoon season from June to October and the second, the cold-weather season from November to March, April. The latter season is more favourable as, in the monsoon planting the harvest usually coincides with the north-east monsoon rains resulting in heavy damage to the bulbs.

Varieties.—There are two popular varieties, the red and the white onion. The latter is inferior to the red in yield, flovour and keeping qualities and hence is not cultivated to any large extent.

Soil.—Onion does well in a wide range of soils, with the exception of heavy clay and alkaline soils. The best yields are obtained in well-drained loamy soils of high fertility. In sandy soils which have been manured heavily bulbs of solid, heavy type with excellent keeping qualities are obtained. As it is an exhausting crop, onion should not follow any heavy feeding crop.

Nursery.—The seedlings are preferably raised in raised beds of any convenient size. The soil must be in a mellow condition with a good dressing of well-rotten cattle manure. About 5 to 6 oz. of seed sown in an area of about 3 cents is generally sufficient to plant one acre. To ensure a good stand, seed must be of high viability. The seed is sprinkled over the beds and lightly covered. Watering should be done daily for about 40 to 50 days when the seedlings will be ready for transplanting.

Preparatory Cultivation.—The field has to be brought to a fine condition before planting is taken up. Transplanting can preferably be done on ridges for the monsoon plantings and in beds for the cold weather plantings. Though yield has been observed to be slightly in favour of bed-planting, ridge-planting is more advantageous in that the size of bulbs is bigger and more uniform and irrigation and weeding are easier. Ridges are formed 12 to 15 inches apart with the help of the country plough.

Manuring.—Onion responds to fertilizers. A basal dressing of 15 to 20 cartloads of farm-yard manure may be applied before plantings. A top-dressing of 800 lb. of groundnut cake meal and 130 lb. of ammonium phosphate per acre applied in two instalments, onee at the time of transplanting and again after about 50 days has been found to be effective in enhancing the yield.

Transplanting.—Seedlings are planted on both sides of the ridges with a spacing of 3 to 4 inches. It is advisable to water the nursery just before lifting the seedlings. The field is given a soaking irrigation before transplanting. While transplanting, it is a good practice to reject all poorly developed seedlings and care must be taken to avoid deep planting as it results in under-sized bulbs. The optimum depth of planting is between 1 and 1½ inches.

After Cultivation.—The crop requires frequent irrigations in the absence of rains. The 'life' irrigation is given about 4 days after planting and later irrigations at intervals of 8 to 10 days. Weeding must be thorough, as the presence of weeds reduces the yield considerably. Deep inter-cultivation should be avoided, as it damages the feeding roots.

Pests and Diseases.—The crop is relatively free from any pest or disease.

Harvesting.—The crop is ready for harvest about 3½ to 4 months after transplanting. As it reaches maturity the leaves turn yellow and droop down. The optimum stage for harvest is when the tops ripen and shrivel and the outer scale leaves of bulb become dry. The bulbs are pulled out with the stalk. An irrigation given 3 to 4 days prior to harvesting, facilitates the pulling out of the bulbs. The crop is dried in the sun for 2 to 3 days after which the roots and leaves are trimmed off.

Storage.—Onion should be stored in single layers in a cool, dry and well ventilated room or shed. Damp conditions reduce its keeping quality. Damaged bulbs should not be included for storage. If storage facilities are not available, the produce has to be immediately marketed.

Yield.—Yield varies from about 6,000 to 10,000 lb. per acre with an average of about 8,000 lb.

Cost of Cultivation.—This varies from place to place and from season to season. However, the following represents the approximate cost per acre.

Pairs at Rs. 4, men at As. 14 and women at As. 7 per day.

Details of Operations.	Labour per acre. P. M. W.	Calculated cost per acre. Rs. A. P.
1. *Preparatory cultivation*—		
Ploughing thrice and forming ridges and channels	6 10 8	36 4 0
2. *Manures and manuring*—		
Transporting and applying manure ..	1½ 1½ 13	13 0 0
Cost of manure	..	122 10 0
3. *Seeds and sowing*—		
Cost of raising nursery	..	35 0 0
Cost of transplanting	0 0 25	10 15 0
4. *Irrigation* (twelve *irrigations on the whole*)—		
Guiding water at 2 men per acre per irrigation	0 24 0	21 0 0
Electricity charges at Rs. 2 per acre per irrigation	..	24 0 0
5. *After cultivation*—		
First weeding	0 0 35	15 5 0
Second weeding	0 0 30	10 5 0
6. *Harvesting*—		
Harvesting, drying and cleaning	0 0 65	28 7 0
7. Rent per acre of garden land	..	100 0 0
Total cost of cultivation per acre	..	416 14 0
Out turn per acre.		
Value of 8,000 lb. at Rs. 2 per md. of 28 lb.	..	572 0 0
Therefore net profit per acre	..	155 2 0

GOVT. PRESS, MADRAS.

LEAFLET No. 8.

Brinjal (*Solanum melongenum*)

Introduction.—Among the Indian vegetables, brinjal occupies a very eminent place. It is a poor man's vegetable even as tomato is of the rich. It is a very cosmopolitan crop and is grown during some season or other in all the districts in the presidency. It is adapted to grow in a wide range of soil conditions from sandy to clay loams. The best yields are recorded in well-drained, rich loams.

Season.—There are two distinct seasons for growing brinjal, the monsoon season extending from June to October and the cold weather season from November to April. Of the two seasons, the latter is observed to be more favourable.

Varieties.—Distinction is made between varieties on the basis of shape and colour. In shape there are round, oval and elongated varieties. In colour there are purple, yellow, green, grey, brownish, ashy and mottled varieties. Among the named varieties Pekin Black Giant, New York, New York Improved and Pocha's Black Beauty are good. Among the local varieties, Puliyampoo has given very satisfactory performance.

Nursery.—The raising of seedlings is similar to that of tomato. The beds are well prepared and manured and are preferably elevated to ensure quick drainage About 4 ounces of seed sown in an area of about 1½ to 2 cents will be sufficient to plant one acre. Irrigation is done every day for about 35 to 45 days when the seedlings are ready for transplanting.

Preparatory cultivation.—The soil must be brought to good tilth before taking up transplanting. The clods must be broken if the field is cloddy. The ridges are then formed as in the case of tomato giving a spacing of 2 to 2½ feet between ridges.

Manuring.—A basal dressing of 15 to 25 cart-loads of farm-yard manure at the time of ploughing is very beneficial to the crop. As brinjal is a heavy feeding crop the cattle manure has to be supplemented with other manures such as groundnut cake and ammonium phosphate. It has been observed that an application of 1,000 lb. of groundnut cake meal in addition to 250 lb. of ammonium phosphate applied in two doses, one at the time of transplanting and another at the time of earthing up has resulted in increased yield.

Transplanting.—It is advisable to take up transplanting in the evenings. The nursery has to be watered before lifting the seedlings. The field is given a soaking irrigation before transplanting. Only healthy seedlings should be used and the spacing given varies from 1½ to 2 feet in the same row depending on the variety. The 'life' irrigation is given on the third or fourth day and later irrigations at intervals of 8 to 10 days. The gaps are filled up with the first one or two irrigations.

After cultivation.—Care must be taken to see that there is no set-back in the growth of the crop either due to weeds or insufficient water or manure. Generally 2 to 3 weedings are necessary to keep down the weeds. The crop is earthed up about 1½ months after transplanting.

Harvesting.—The first picking can be done about 60 days after transplanting. Picking is light for about a month; but thereafter for about 2 months the crop is in full flower.

Pests and diseases.—The common pests are the Epilachna beetle, the lace wing bug and the shoot-borer (*Leuinoides orbonalis*). When present in large numbers, these are capable of causing considerable damage to the crop. The first two defoliate the plant, while the shoot-borer burrows into the

tender shoots and is responsible for their sudden drying up in large numbers. The most effective method of control is by hand-picking which has to be done systematically.

Epilachna beetle is controlled by dusting or spraying with calcium arsenate in the proportion of 1 : 6 (cal. arsenate one part to 6 parts of lime). As the black lace wing bug occurs in colonies on the underside of the leaves it can be controlled by spraying with a contact insecticide like tobacco decoction with soap.

Yield.—Yield varies considerably depending on several factors. The average yield can be estimated at about 12,000 lb. per acre.

Cost of cultivation per acre—

Pairs at Rs. 4, men at As. 14 and women at As. 7 per day.

	P.	M.	W.	Rs.	A.	P.
1. *Preparatory cultivation—*						
Three ploughings	6	6	0	29	4	0
Forming ridges and channels and rectifying them	1	4	0	7	8	0
2. *Manuring—*						
Carting and applying 15 cart-loads of farm-yard manure	1½	1½	5	9	8	0
Applying 1,000 lb. of groundnut cake meal and 250 lb. of ammonium phosphate ..	0	0	10	4	6	0
Cost of 15 cart-loads of farm-yard manure at Rs. 4 per cart-load		..		60	0	0
Cost of 1,000 lb. of cake at Rs. 120 per ton..		..		54	0	0
Cost of 250 lb. of ammonium phosphate at Rs. 14–10–0 per 100 lb.		..		36	9	0
3. *Seeds and sowing—*						
Cost of 4 oz. of brinjal seed at Re. 1 per oz..		..		4	0	0
Cost of raising seedlings sufficient to plant one acre		..		11	14	0
Transplanting seedlings including *filling up* gaps	0	0	10	4	6	0
4. *After cultivation—*						
Two weedings at 22 women per weeding ..	0	0	44	19	4	0
Earthing up	0	0	8	7	0	0
5. *Irrigation* (15 *irrigations*)—						
Guiding water at 2 men per acre per irrigation	0	30	6	26	4	0
Electricity charges at Rs. 2 per irrigation ..		..		30	0	0
6. *Harvesting—*						
Picking brinjal which continues for about 3 to 3½ months	0	0	50	21	14	0
7. Rent on 1 acre of garden land		..		100	0	0
Total cost of cultivation		..		436	0	0
Outturn per acre—						
Value of 12,000 lb. at Rs. 6 per 100 lb.		..		720	0	0
Therefore net profit per acre		..		284	0	0

MADRAS: PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS.

Leaflet No. 9.

AGRICULTURAL DEPARTMENT—MADRAS.

Jams, Jellies and Marmalades

The manufacture of jams, jellies and marmalades is one of the best known and most important of the fruit products industries. Large amounts of cull fruits which cannot be used for canning or sold as first-class fresh fruit are used for these. These products can easily be prepared on a small scale at home also, when fruits are available in large quantities and are cheap. The industry can be run also as a profitable cottage industry. In South India, there are a large number of different kinds of fruits, and experiments have shown that very good products can be prepared from several of them.

Different kinds of products.—There is a slight difference in the preparation of these different kinds of products. A *jam* is prepared from the whole fruit by boiling the pulp with sugar to a fairly thick consistency. The finished product should contain about 70 per cent of soluble solids of which about 65 per cent will be the added sugar. When the jam is prepared from fruit pulp which has been sieved to make it fine, and spices are added during boiling, the product is called a "*Fruit butter.*" When the prepared fruit is cooked in sugar syrup until the concentration of sugar reaches 60–70 per cent and the fruit retains its form, the product is called a "*fruit preserve*" or "*Murabba.*" Murabbas of apples, quinces, etc., are well known Indian products. When screened fruit pulp is sun-dried or "dehydrated" to a solid consistency, it becomes a "*fruit paste*" or "*fruit leather.*" Mango leather (or Mango Thandra) is a well-known product. "*Candied fruits*" are those which have been impregnated with sugar by repeated boilings in syrups of gradually increasing strength (up to 70–72 per cent) and then dried. *Candied* fruits are often "*glaced*" with a concentrated solution of sugar and glucose to give the product a shining appearance.

Jelly.—A jelly is prepared by boiling the fruit slices just covered with water to extract the pectin, straining expressed juice, adding sugar to it and concentrating it till it gelatinises on cooling. The amount of sugar to be added varies from ¾ to 1¼ of the weight of extract, depending upon its richness in pectin. The jelly should be clear, transparent and shining. It should not be syrupy or sticky. It should be tender, but firm, so that it can be cut leaving a clean edge. When removed from the mould, it should retain its form and quiver gently without flowing.

Marmalade.—A clear fruit jelly in which slices of fruit or peel are suspended is a marmalade. Marmalades are generally prepared

from citrus fruits. There are two kinds, one being sweet and the other slightly bitter.

Principles.—The three important factors concerned in the formation of jams and jellies are the pectin, the acid and the sugar. Pectin and acid are present in many of the fruits in sufficient quantities. The sugar content has, however, to be increased by adding sugar. When pectin, sugar and acid are combined in certain proportions, the mixture sets to a gel. For satisfactory gel formation, the pectin content should be about 1 per cent and the acidity about 3 0–3·1 p-H.

Preparation of jelly.—Fruits used for jelly making should contain sufficient pectin and acid. Guavas, apples, limes, oranges and grapes are rich both in pectin and in acid. Bananas are rich in pectin, but poor in acid. Apricots are rich in acid but low in pectin. Fruits are often blended to make up for any deficiency in pectin or acid. Recently, pure commercial pectin is being employed on a large scale. Tartaric acid is preferable to citric acid for raising the acidity.

(i) *Extraction.*—The fruit is cut into slices and heated with water just sufficient to cover for 15-30 minutes. The heated pulp is placed in a cloth jelly bag and allowed to drain. A second extract is taken from the residue. The two extracts are mixed and tested for pectin as follows :—

(ii) *Pectin test.*—A spoonful of extract and a spoonful of 95 per cent alcohol are mixed in a glass tumbler. If one jelly-like mass is formed, the extract is rich in pectin. Several large lumps indicate medium pectin content. A small stringy precipitate is formed by extracts poor in pectin.

(iii) *Addition of sugar.*—To extracts rich in pectin 1–1½ their weight of sugar may be added. Medium extracts can take up only about ¾ their weight of sugar. Poor extracts should be concentrated by boiling. Recently a simple gadget called " jelmeter " has been introduced to facilitate the determination of the amount of sugar.

(iv) *Boiling; flake-test; packing.*—The sugar is stirred with the extract in a kettle and boiled rapidly. The scum is removed. The end point is reached when the temperature of the mixture is 220–221°F, i.e., 8–9°F above the boiling point of water. Another simple test is the " sheet " or " flake " test. A wooden skimmer is dipped into the boiling mixture, taken out and allowed to cool. If the liquid drips as a thin syrup, boiling is incomplete; if it drops off in flakes or sheets, then boiling is complete. The finished jelly is poured hot into glasses or jars which are hermetically sealed. For home use, the surface of the jelly may be covered with paraffin wax to prevent moulding.

Preparation of jams.—Jams may be prepared from almost all varieties of fruits and also from some vegetables like tomatoes, carrots, etc. Mixed fruit jams are also popular.

The fruit is sliced and crushed and stones, core, pits, etc., are removed. The pulp is softened by heating with ¼–⅓ its weight of water. The fruit-sugar ratio is generally 1 :1 or 1 :¾. In the case of sweet fruits, tartaric acid to the extent of 0·5 per cent of the total weight of fruit and sugar taken may be added with advantage. The fruit sugar mixture is boiled rapidly to 219–221° F or until the sheet test is satisfactory. The finished jam is filled hot into jars or cans and sealed. If the jam contains a high percentage of sugar (70 per cent or more) it will not spoil easily.

Marmalades.—Citrus marmalades are very popular. They are prepared generally from bitter varieties of oranges like Kichili or from sweet oranges mixed with ¼ to ⅓ their weight of limes or lemons or bitter oranges. The shreds are taken from the peel of sweet oranges. The outer skin of oranges is peeled with a knife and the fruit is cut into slices ⅛ inch thick. Limes are sliced. The slices are just covered with water and heated for 15–20 minutes to extract the pectin. The extract is strained through a flannel bag or thick drill bag. The yellow outer peel of 3–4 oranges for every 10 oranges taken is cut into thin shreds about 1/16 inch thick and ¾–1 inch long. The shreds are boiled in two or three changes of water for 10–15 minutes to remove the bitterness and make them soft. The extract sugar mixture (1 :1) is boiled rapidly to finish, the shreds being added just before the end point. The marmalade is poured hot into jars or cans and sealed.

Preparation of some important jams, jellies, etc.—(i) *Plum jam.*—Both sweet and sour plums can be used. Stones are removed by cooking the fruit with ¼ its weight of water. The pulp-sugar ratio is 1 :1. In the case of sweet plums, 0·5 per cent tartaric acid may be added. The jam is of excellent taste and flavour.

(ii) *Jack jam.*—The ripe carpels are softened by heating with 1/5 their weight of water. Pulp-sugar ratio 1 :¾; acid, 0·5 per cent. The jam is golden yellow in colour, and has a very strong and characteristic flavour.

(iii) *Mango jam.*—Bangalora, Neelum, Baneshan, Mulgoa mangoes can be used. Fruit-sugar ratio 1 :¾, acid 0·5 per cent. The finished jam has attractive golden yellow colour, good taste and the flavour of the fruit used.

(iv) *Muskmelon jam.*—The pulp is crushed. Pulp-sugar ratio 1 :¾; acid 0·5 per cent. One ounce of thinly shredded ginger and lemon slices per every 100 lb. of pulp will greatly improve the taste and flavour. Melon jam is a well-known product.

(v) *Woodapple jam.*—The pulp is scooped out. Pulp-sugar ratio 1 :1; acid 0·5 per cent. The jam is quite good.

(vi) *Banana jam.*—The pulp is crushed and mixed with ¾ its weight of sugar and tartaric acid at 0·5 per cent. The jam has good taste, but mild flavour.

(vii) *Amla jam.*—The stones are removed by cooking the fruits for 10–15 minutes in a cloth bag in boiling water. The pulp is crushed. Pulp-sugar ratio 1 :1; acid is not added. The jam is pale yellow in colour and has a characteristic taste and flavour. It is of special interest as a tonic.

(viii) *Custard apple jam.*—The pulp is rubbed through a sieve to remove the seeds. Pulp-sugar ratio 1 :¾; acid 0·5 per cent. The jam has mild flavour only.

(x) *Other jams and jellies.*—Pineapple—carrot mixed jam, tomato jam, carambola jam, orange marmalade, guava jelly, wood-apple jelly, Kumquat marmalade, etc., are other interesting and useful products which can be prepared easily at home.

At the Government Fruit Products Research Laboratory, much work is being done on almost all aspects of fruit and vegetable preservation. The Biochemist, Kodur P.O., Cuddapah district, who is the specialist in charge of this work will be glad to welcome visitors to the Research Laboratory and help them with advice and guidance in every way.

G. S. SIDDAPPA,
Biochemist, Kodur, Cuddapah district.

LEAFLET NO. 10.

Utilization of Cashew Apples

Cashew apples are grown extensively on the West Coast and along the East Coast of Madras Presidency. The cashew apple tree is a hardy plant and can be successfully grown in several tracts. On the West Coast, round about Mangalore the cashewnut industry has recently been built up to a considerable extent. The nuts are broken after roasting and the kernel known as cashew-nut is graded and packed in gas sealed tins for export to America and other countries. Although this industry is a large and thriving one, very little use has been made of the cashew apple itself. The fruit, when fully ripe, is of a bright yellow or orange colour and is full of juice which can be easily pressed from the fibrous tissues. The freshly extracted juice is very astringent in taste and turns brown quickly due to enzyme action. Experiments at the Fruit Products Research Laboratory, Kodur, have shown that excellent quality cashew apple syrup can be prepared from this juice. The method developed is briefly described in this note.

Preparation of Cashew Apple Syrup

Fully ripe cashew apples are washed in water and drained. They are cut into halves or quarters, placed in cloth and pressed in a wooden basket press to extract the juice. Contact with iron parts should be avoided as it leads to discolouration of the juice. The freshly expressed juice is heated rapidly to boiling and cooled quickly. On heating, the proteins get coagulated and browning due to enzyme action is arrested. The heated and cooled juice is allowed to settle overnight in a glass jar or aluminium vessel and the clear supernatant liquid syphoned off the next day for preparing cashew apple syrup. The clear juice is generally of about 10 degrees Brix and of about 0.2 per cent acidity as citric acid. Since the juice is low in acidity, it is necessary to raise it by adding citric acid or lime juice. Blending of the juice with half its quantity of lime juice gives the proper degree of acidity in the final product. On adding lime juice, a copious flocculent precipitate is formed. Although the precipitate shows a marked tendency to settle down quickly, it cannot be removed easily by filtering through cloth. Citric acid may also be used instead of lime juice. Calculated amount of sugar is added to the clear blended juice and the mixture heated to dissolve the sugar and remove any scum. The syrup is then cooled quickly to about 120-125° F. before adding the preservative, potassium metabisulphite, which has been found satisfactory. It is added to the syrup at the rate of

0.06 per cent, which approximately corresponds to one ounce of the chemical per 100 lb. of the syrup. At this concentration, which is within prescribed limits, its addition is harmless. It helps to preserve the syrup for a long time in storage. The calculated quantity of the chemical is dissolved in a small quantity of boiled and cooled water and stirred up with the syrup. The syrup is then filled into clean bottles which have been previously sterilized by boiling in water for 30 minutes. The bottles are closed with crown corks or ordinary corks of good quality. In the latter case, the mouth of the bottle is dipped in melted paraffin wax to improve the air tightness of the seal.

The freshly prepared product has a strong astringent taste and flavour and has a catching effect on the throat. This, however, tones down completely during storage of the bottled product for about three months. During storage, the product generally develops a light purplish colour which makes it look very attractive. The taste and flavour of the stored product improve considerably during preliminary storage for about three or four months. In view of the abundance of the raw material, which is at present going to waste, there is every chance for the quick development of this interesting and useful food product.

Cashewnut oil.—Cashewnut shell liquid obtained from the shell has recently become an important industrial product as a result of research work done in America. This viscous liquid, which is poisonous and has a strong vesicant and dermatic action—on the human skin, has proved to be an important raw material for the plastic industry. Recently cashew resins and polymers have been developed for use in solvents, plasticisers, brake linings, industrial floorings, rubber substitutes, etc. In fact, a number of uses have been forecast for this interesting raw material. The work in India on this subject appears to be very little so far. After extraction of the oil from the shell, it should be possible to prepare some type of active carbon from the shell.

At the Fruit Products Research Laboratory, Kodur, Cuddapah district, much work is being done on the standardisation of methods for the preparation of a large number of fruit juices, squashes, syrups and cordials. Those who are interested in this industry are welcome to seek advice and technical help from the Biochemist, Fruit Canning and Preservation Work, Kodur P.O.

DR. G. S. SIDDAPPA, M.A., PH.D., A.R.I.C.,
Biochemist.

MADRAS: PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS.

LEAFLET No. 11.

DEPARTMENT OF AGRICULTURE, MADRAS

COCONUT CULTIVATION

The coconut is essentially a tropical palm thriving well within 23° north and south latitudes and up to an altitude of about 3,000 feet above the sea level. In India it grows luxuriantly in the coastal and the deltaic tracts as also in some of the interior uplands of Mysore, where a good supply of soil moisture and proper drainage are assured. To make the coconut yield well and be remunerative, it is necessary to grow it on suitable soils even though the palm is capable of adapting itself to varied conditions of soil and climate.

2. *Soil.*—The best soil for the coconut is rich alluvium with a fair proportion of sand or coarser particles that ensure proper drainage. Extensive plantations are met with in laterite loamy soils. Coconuts also thrive and yield well when planted in black clayey soils, on bunds of canals or channels and on the banks of rivers. They can be successfully grown even in sandy soils provided there is an assured supply of good underground water within the reach of the roots and the trees are properly manured. Soils lacking in water-holding capacity and suffering from excessive dryness or improper drainage are unfit for coconut cultivation. In other words, proper supply of soil moisture either through well distributed rainfall, percolation water or irrigation, and sufficient drainage are essential for coconuts and extensive planting should be undertaken only in lands satisfying these conditions.

3. *Varieties.*—Of the varieties of coconuts available in different countries, the tall variety and the short or the dwarf variety are the most striking ones. The tall variety is the one that is largely cultivated in India and elsewhere for commercial purposes. It is a long-lived (80 years) hardy palm yielding nuts, copra, oil and fibre of good quality. These trees also yield on tapping good quantity and quality of juice for the production of jaggery and sugar. Among the tall variety, growers recognize different sub-varieties based on the colour, shape and size of nuts and their bearing nature. Trees yielding large number of medium sized round nuts are considered the best for propagation on a plantation scale. The tall variety commences to yield in about 8 to 10 years after planting when raised under unirrigated conditions. The dwarf variety, on the other hand begins to yield in about four years after planting. But it is a delicate, short-lived (30 years) palm susceptible to fungus and insect attacks. Moreover, the nuts of the dwarf variety are small and the quality of the copra is inferior. Although some people like it for its earliness in bearing and attractive colour of the nuts, it is never recommended for cultivation on a large scale.

4. *Seed material.*—In view of the fact that the bearing capacity of a coconut palm can be properly judged only in about fifteen years after planting and that a tree easily lives for about eighty years, the selection of proper planting material that will ultimately give high yields, is of utmost importance. Any neglect in this respect cannot be easily remedied when once the trees get established and a plantation containing trees giving poor or indifferent yields will result in loss to the planter as long as it lasts. To obtain proper seed material, selection has to be done on the following lines :—

(*a*) *Selection of parent trees.*—(i) Parent trees have to be selected from a garden which contains healthy middle-aged and properly bearing trees and which does not require irrigation during the dry months of the year.

(ii) They should be heavy yielders giving about 100 or more nuts per tree per year. The yearly yield of a tree can be roughly estimated by counting all the nuts on the tree from the youngest to the oldest, as the coconut palm bears a year's crop in its crown.

(iii) The trees should be regular bearers, yielding heavy crops every year instead of in alternate years.

(iv) The trees should be healthy, vigorous and robust with a thick set crown, spherical in outline, having many leaves borne on short, thick stalks. The peduncles or stalks of bunches must be stout and should not show tendency to buckle or droop down.

(v) Trees having medium-sized nuts with nearly round shape are better than others, because such nuts are associated with heavy yield and high copra content.

(vi) Avoid trees growing close to houses or other favoured conditions as it is difficult to differentiate intrinsically good ones in such places.

(vii) Avoid trees producing barren nuts, i.e., nuts which are empty or do not contain well developed kernel inside or trees that shed their nuts before they are fully mature.

(*b*) *Selection of seed nuts.*—(i) Select medium sized, round nuts when they are fully mature but not dead ripe. Nuts are fully mature when they are about 12 months old after the opening of the female flowers. Such nuts can be easily distinguished from the colour of their husk and the quantity of water contained in them.

(ii) Discard a few nuts at the base and at the top of the bunch, as also nuts having cracks or any unhealthy signs about them. These are inferior for seed purposes.

(iii) Reject nuts which do not show signs of the presence of water or 'milk' inside, and those having loose kernel which rattles on shaking.

(iv) Nuts ready for harvest during the months of February to about the middle of May every year are the best and should be selected for seed purposes as they give a high percentage of germination and produce vigorous seedlings.

(*c*) *Harvest and preservation of seed nuts.*—In hard soils bunches of seed nuts are cut and lowered by means of ropes to avoid damage that may result due to the fall from the crown. The seed nuts may be stored for about a month till the husk becomes dry before they are put in the nursery. If seed nuts are stored for four or five months, they become overdry and the water (milk) inside the nut disappears and the kernel at times rattles. Such nuts are not fit for sowing as they do not germinate. To prevent seed nuts from drying, they are best preserved in sand instead of exposing them direct to the atmosphere. For this the seed nuts are spread with the stalk end up on the floor of a shed over a layer of about 3 inches of sand and the nuts completely covered up with sand and thus protected from the direct action of the atmosphere, till they are required for sowing.

(*d*) *The nursery.*—The best place for a nursery is sandy soil located near a well or other water source. In places where sandy soil is not available the seed bed has to be made up of sand by digging out the required area to a depth of about a foot and a half and removing the soil and filling it up with sand. This is necessary to prevent white-ant attack and to provide proper drainage. The seed bed may be of any convenient breadth, say about 5 feet, to facilitate watering. In places severelly infested with white-ant, it is customary to char the sides of the pit by burning rubbish in it to prevent the spread of white-ant infestation into the nursery area.

The nuts are buried in the seed bed in a horizontal, vertical or oblique position with the stalk end up so that the husk appears just above the surface of the soil. A spacing of about a foot and a half from nut to nut will be quite convenient if the seedlings are to remain in the nursery for over a year. It is not usually necessary to manure the seed beds. Manuring with organic manures like farmyard manure which attract white-ants should be avoided.

The nuts may be planted with advantage in June or July with the beginning of the south-west monsoon or in October or other rainy months. Planting in the rainy months saves watering charges, as profuse watering has to be done in the initial stages, usually on alternate days. Germination of nuts commences in about three months after planting and ends in another two months. Usually from 90 to 95 per cent of seed nuts germinate. Regular watering of the nursery and shading of the seedlings during the summer months are necessary till the seedlings are transplanted.

(*e*) *Selection of seedlings.*—Selection of seedlings is as important as the selection of parent trees and seed nuts. The points to be noted in the selection of seedlings are :—

(i) Seedlings should be healthy, vigorous and robust looking with large number of leaves, good girth at the base, short, thick leaf stalks and large number of roots.

(ii) Early germinated nuts give better seedlings than the late germinated ones and are associated with early bearing.

(iii) Early splitting of leaves into leaflets is a good sign of vigour.

(iv) Unhealthy seedlings, with poor, stunted growth and those that are thin and lanky should be rejected.

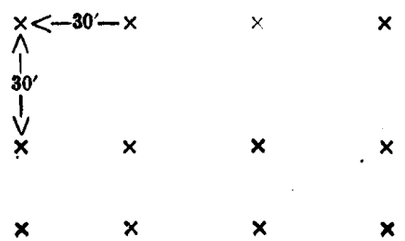
By such rigorous selection about 20 to 40 per cent of seedlings get rejected. Therefore sufficient number of seed nuts should be planted in the nursery to get the required number of selected seedlings.

The best time at which seedlings can be removed from the nursery for transplanting is when they are about a year old. The seedling should not be pulled out of the seed bed by force, but the roots should be neatly cut and the seedling with the nut gently removed by holding the nut. Younger seedlings establish more quickly when transplanted than the older ones but they are subject to damage in transit, attack by white-ants in the field, and may not withstand water logging in the rainy months. Seedlings two or three years old are generally preferred for planting on bunds of rice fields or similar situations and after planting they have to be held firm by suitable props for about a year till the seedlings strike roots and get established.

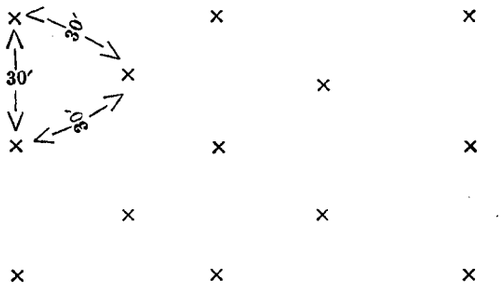
5. *Spacing of trees.*—If coconut trees are to bear well, plenty of sunlight is necessary. Where trees are overcrowded there is a tendency for them to grow tall and lanky in their struggle to get at sunlight and considerable energy is utilized in producing a tall trunk at the expense of yield. Also in closely planted gardens rat trouble may be serious as the rats find easy access from tree to tree due to overlapping of leaves. A spacing of about 25–30 feet between adjacent trees or about 80 to 60 trees per acre may be considered suitable for most places though in certain rich soils under favourable conditions even 100 trees per acre may be planted with advantage.

6. *Method of planting.*—Planting should be done in straight rows at regular intervals to facilitate proper cultural operations being carried out with labour saving implements. There are two methods of planting commonly adopted, viz., the square method and the triangular method which are indicated below :—

Square method—



Triangular method—



In the triangular method of planting more trees can be put in than in the square method as shown hereunder :—

Spacing in feet	Number of plants per acre	
	Square method	Triangular method
24	76	87
25	70	80
26	64	74
27	60	69
28	56	64
29	52	60
30	48	56

7. *Depth of planting.*—The depth at which seedlings should be planted in relation to the ground level depends upon the nature of the soil and the height of the water table. The higher the water table the more shallow should be the planting. In most red loamy (laterite) soils three feet deep planting will suffice. In hard gravelly soils where the water table is low planting at a depth of even four feet may be necessary. In rice fields and backwater areas which are proposed to be converted into coconut gardens by gradually raising the level of the land by the addition of river silt and sand, seedlings should be planted on mounds 2 to 3 feet high and about 3 feet across raised for the purpose, and the interspaces filled up as the trees progress in growth. Under the dry system of coconut cultivation, in places where the water table is low in summer it is inadvisable to plant seedlings on the surface of the soil in shallow pits about a foot deep and just sufficient to cover the nut of the seedling. In this system of surface planting, the bole area available for root production is very limited and the roots get exposed and the plants suffer much in the dry weather. It should be remembered that the base of the trunk to a height of 2 or 3 feet is the root bearing region and should therefore be well within the soil.

8. *Pits for planting.*—Pits may be about three feet wide and the depth varying according to local requirements as already mentioned. Three feet cube pits may be suitable for most localities. Pits are dug at regular intervals about two or three months prior to the time

f planting and allowed to weather. The sides of the pit are charred y burning rubbish or dry leaves in the pit to prevent white-ant ttack.

9. *Planting.*—It is a good practice to provide a foot of loose soil made up of earth, sand and ash (10 lb.) at the bottom of the pit while planting. The seedling is kept in position at the bottom of the pit and the nut is covered up with the soil which is pressed down. The best time for planting is during the rainy months. If strong winds prevail, the seedlings have to be held in position by proper supports to prevent them from shaking which hinders root formation. When the sun is rather hot, seedlings have to be shaded by sticking up bits of coconut leaves by the side of the seedling.

10. *Care of plantation*—(*a*) *Fence.*—The young coconut plantation has to be protected by a suitable fence against cattle trespass till the trees grow tall enough to be beyond the reach of cattle. This is very important for the successful raising of a coconut garden as seedlings eaten up by cattle off and on, seldom grow into good bearing trees. The fence once put up should be periodically attended to and repaired. On the West Coast mud or laterite stone walls are usually constructed along the boundary of a plantation.

(*b*) *Watering.*—Transplanted seedlings should be watered regularly in the absence of rains till they strike roots and get established. Watering should also be done in the dry and summer months. The practice is to water the seedlings on alternate days in the first year of planting and once or twice a week in the subsequent years till the plantation is about six years old.

(*c*) *Cultivation and after-care.*—The garden should be laid out into convenient blocks with proper bunds and drainage channels according to the slope or contour of the land. The soil should be cultivated and kept free from weeds. The seedlings should be frequently examined for any insect attack or fungus disease and remedial measures adopted in time.

11. *Catch crops.*—Catch crops are usually grown for about five years after planting. In South India, the common catch crops are Colocasia, yam, tapioca, sweet potato, pulses, ragi, varagu, samai, cholam and dry paddy. The best crops are perhaps pulses that renovate the soil or which do not exhaust the soil too much.

12. *Manures and manuring.*—For the proper maintenance of coconut plantations, manuring has to be done systematically. The poorer the soil, the greater the quantity of manures required. To make the tree yield properly manuring has to be done judiciously with a view to get economic returns. The effect of manuring and cultivation on the yield of the trees can be noticed only after a period of three years, and these operations have to be carried out regularly every year to maintain the good condition of the trees and the yield at a high level.

Ash, particularly that obtained by burning leaves, husks, etc., of the coconut is the cheapest, easily available and the most popular manure used for the coconut on the West Coast. It should be stored properly and should not be exposed to the leaching action of rain. Ash may be applied at the rate of 20 lb. or more per tree, per year. The best manure, however, is 3 lb. to 4½ lb. of ammonium sulphate or 10 lb. to 15 lb. of groundnut cake and 20 lb. to 30 lb. of ash per tree per year in addition to the raising and ploughing in a green manure crop (cowgram, sunn-hemp, *Crotalaria striata*, etc.) besides regular cultivation of the soil. Ash and ammonium sulphate should not, however, be mixed and applied. There should be an interval of about a month between the application of the two manures. Well rotten cattle manure at the rate of 100 lb. per tree per year is also one of the best manures. The other manures commonly used are fresh fish (40 lb.), fish guano or meal (10 lb.), green leaves (50 lb.), and potassium sulphate (1½ lb.) in place of ash. Tethering of cattle in the gardens at night and covering up the dung and urine with soil on the following morning as practised in some localities is worth adopting.

Coir dust obtained in the manufacture of coir fibre from coconut husk, though it does not contain any manurial ingredients is a good agent for increasing the moisture retaining capacity of the soils. It can be mixed with other organic manures and buried in trenches about a foot deep between rows of palms.

Coconut husk is rich in easily available potash—the most important manurial requirement of the coconut palm. In places where husk is not utilized for coir-making and therefore very cheap, it is highly desirable that it is buried in the plantations under rainfed conditions at the rate of about 500 to 1,000 husks per tree. Trenches 6 feet wide and a foot or a foot and a half deep are dug between rows of palms and on layers of dry coconut leaves the husks are spread with the hollow face up along with other farm rubbish. The trenches are thus filled up and covered with soil. The effect of burying husks is as good as the application of ammonium sulphate and ash provided a green manure crop is grown and incorporated into the soil every year. The beneficial effect of a single application lasts for about 5 to 8 years. Also the husk acts as a "water reservoir" during summer months and helps in the retention of moisture in the soil. The important point to be remembered in this connexion is that the husks meant for burying should not have been exposed to rains, for by so doing the easily soluble potash in the husk is washed off.

The proper time for the application of manures or for manurial operations is when there is sufficient moisture in the soil. At the same time care should be taken to see that the manures applied are not washed off during heavy rains. All precautions should be taken in plantations against soil erosion by levelling, terracing and erecting proper bunds wherever necessary. Weeds also should not be allowed to rob the coconuts of their manure. They should be checked by regular cultivation.

The manures recommended here are best applied after the heavy ains. There should be an interval of about a month between the pplication of ash and ammonium sulphate. The manures may be pplied broadcast and then ploughed into the soil. Cattle manure nay be applied as a basal dressing at the time of sowing the green nanure crop at the beginning of the south-west monsoon rains.

13. *Cultivation.*—Inter-cultivation in bearing gardens is of the greatest importance as it improves the yield of trees to a remarkable extent even without manuring. At the Agricultural Research Station, Kasaragod, in South Kanara district (under unirrigated conditions) regular inter-cultivation alone without any manuring increased the yield by 171 per cent, while the yield of the uncultivated and unmanured trees declined by 7 per cent.

The importance of cultivation is recognized by many garden owners and they dig the garden with mammuties once or twice in a year. Digging is more costly than ploughing. In loamy soils digging may cost about Rs. 10 or more per acre and ploughing with iron plough may cost only about Rs. 5 per acre. There is also the common practice of digging around each tree to a radius of about 4 or 5 feet leaving the rest of the garden uncultivated. But this has been found by experiment to give only an increase of 2·8 nuts per tree as against 39·9 nuts given by trees in the completely cultivated plot.

The following is the schedule of manuring and cultivation best suited to West Coast gardens and can with slight modifications be adopted elsewhere to suit local conditions of rainfall, cost, availability of manure, etc. :—

March-April.—One ploughing with iron plough to prepare the land to receive the summer showers.

June.—When there is slight lull in the south-west monsoon, give a basal dressing of ash at 20 lb. to 30 lb. per tree or cattle manure at 100 lb. per tree and sow a green manure crop preferably in plough furrows at 25 lb. per acre as a green manure crop.

September.—Slash or cut down the green manure and plough it in with a suitable iron plough. If ammonium sulphate (3 lb. to 4½ lb. per tree) is proposed to be applied, it may be broadcast and ploughed in along with the green manure crop at the first or second round of ploughing. Alternately if cattle manure has not been applied as a basal dressing for green manure crop this may be applied in September and worked in.

October.—If ash is not already applied it may be broadcast now and a cultivator worked to incorporate it into the soil. Bunds washed off during rains must be rectified and all drainage vents blocked up.

December.—Work the cultivator again to remove weeds and create soil mulch.

14. *Irrigation.*—Want of sufficient moisture in the soil limits the production of nuts. It is therefore very desirable that coconut gardens are irrigated particularly during the summer months if there are facilities for irrigation.

15. *Yield and harvests.*—Under favourable conditions, coconut palms commence to flower in about five years after planting. In loamy soils it may be in 7 or 10 years and in poor soils it may be as late as 15 or 20 years after planting. In about five years after the commencement of first flowering, the trees begin to yield normally.

As already mentioned, coconut gardens should be regularly cultivated and manured every year and taken care of; neglect of trees even for a year is reflected on the crop in succeeding years.

Properly maintained and regularly cultivated and manured gardens yield from 60 to 100 nuts per tree, per year in loamy unirrigated soils. In neglected gardens the yield may be 20 nuts or less per tree, per year.

It is a good practice to harvest nuts only when they are fully mature, unless for special markets less mature nuts are required. The husks of fully mature nuts become dry in a short period after harvest and dry husks are not valued for the manufacture of coir.

Coconuts are best harvested once in every month or in forty days. On the West Coast coconuts are harvested six to eight times in a year. When the interval between two harvests is long two bunches are harvested from a tree at a time.

16. *Copra.*—The price of nuts depends upon the quantity and quality of copra that can be obtained from them. Fully mature nuts yield the largest quantity and best quality of copra and give high grade oil when milled. Copra obtained from immature nuts is inferior and gives oil of poor quality. By harvesting nuts two months before maturity the loss in the quantity of copra is nearly one-fifth. The nuts harvested in the summer months are larger in size and yield more copra and oil than those of other months. Larger quantity of copra per nut is also obtained from manured trees than from nuts from unmanured trees. The copra content of the nut increases by about 3 to 5 per cent when unhusked nuts are stored for about a month or two.

The best quality of copra is made by breaking husked nuts into halves and drying them in the sun for a period of about seven days. Copra made during the rainy season by " smoking " near a fire place is of inferior quality being sooty and the oil expressed from it is coloured and smells of smoke.

Copra is liable to deteriorate very rapidly if it is not dried properly and when stored under ordinary godown conditions. It is advisable to store only well dried copra in a dry and well ventilated place free from rats and insects. If storage for a long period is necessary it should be periodically dried in the sun.

21. *Recommendations.*—(i) Select suitable land to plant the coconut on a large scale. Avoid very poor soils.

(ii) Obtain good planting material from the Government Coconut nurseries. If this is not possible, the following procedure may be adopted. Select the best seed nuts from healthy heavy yielding trees; raise your own nursery. Select the best seedlings.

(iii) Deep planting is better than surface planting. Triangular method of planting economizes space more than the square method. Planting in straight rows facilitates cultural operations with implements. Trees should not be spaced less than 25 feet apart.

(iv) Fence the garden properly and protect the seedlings from cattle trespass. Provide necessary bunds and lay out the garden into convenient plots to facilitate cultural and manurial operations and to prevent soil erosion.

(v) Water the transplanted seedlings in the absence of rains till they get established and again in the dry and summer months for about six years.

(vi) Guard against white-ant attack.

(vii) Regular cultivation and manuring of the soil are the most necessary operations. Ammonium sulphate, groundnut cake or cattle manure, ash and a green manure crop form the best combination of manures of the coconut. Never neglect proper and periodical cultivation of your garden.

(viii) Harvest only fully mature nuts unless immature nuts are required for special purposes.

(ix) Search the trees for diseases and pests and give timely and necessary treatment. Regular search for and destruction of Rhinoceros beetle will increase yields.

(x) Bestow proper care and sustained attention on your coconut garden and a steady income will be assured to you.

Agricultural Research Institute,
Lawley Road P.O., Coimbatore.

C. M. JOHN,
Oilseeds Specialist.

MADRAS: PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS.

A Short Note on Potato Cultivation

The potato (*Solanum tuberosum*) is the most important food crop grown on the Nilgiris occupying 19,500 acres. It thrives best at elevations between 3,000 to 7,200 feet in the taluks of Coonoor and Ootacamund with a cool and equable temperature and evenly distributed moderate rainfall of 60 inches during 8 to 9 months of the year. In recent years, the cultivation of potatoes has been extended to many districts in the plains where fair crops are grown under irrigation in the cold weather months of November and March but fresh seeds have to be obtained from the hills annually as the seed will not keep in the plains during the hot season.

Seasons.—There are three well defined seasons for potato crop on the Nilgiris. An early crop is grown under irrigation between February and May on a small scale over 1,500 acres. The main crop which covers 11,000 acres is planted in March-April (*Karbogum*) and harvested in August-September. The second crop (*Adibogum*) over 7,000 acres is raised between August and December. Both the main and the second crop are purely rainfed.

Varieties.—Out of numerous varieties tried so far, Great Scot a 3½ months variety is found best suited for this Presidency for its yield, shape, earliness, good keeping quality, and hardness when cooked. Second in preference comes Royal Kidney. Kerr's Pink a longer duration variety finds favour in the plains due to its higher yielding capacity.

Soil.—This crop comes up best on a well drained deep, friable red loamy and slightly acidic soils.

Seed material and seed rate.—On the Nilgiris the seed harvested from the irrigated crop in May is used for planting second crop in August-September. The seed material from a limited area of irrigated crop is always insufficient to meet the requirements of second crop. Under such circumstances the seed tubers from the

17. *Tapping*—Tapping the unopened inflorescences (flower bunches) of the palm for toddy is a common practice in most tracts where the coconut is cultivated. Three weeks after the commencement of tapping, the juice begins to flow and the flow lasts for about a month. The average yield of juice per palm, per day, is about 3½ lb. In a tree the maximum quantity of juice is obtained in the third month after the commencement of tapping. Trees which yield large number of nuts also yield large quantity of juice. Tapping improves the yield of nuts of poor bearers only; and the beneficial effect of tapping lasts for about four years after it is discontinued. For dry localities tapping should be confined only to the rainy months of the year and discontinued after four seasons.

18. *Under-planting.*—Under-planting in old gardens is best started when the palms are about 60 to 70 years old. The old trees may be cut down when their yield goes down as low as 10 nuts per tree per year. This affords a better chance for the newly planted trees to thrive. Under-planting of new seedlings should be done sufficiently away from the old trees. It is undesirable to start under-planting too early, when the garden is only about 30 or 40 years old except in surface planted gardens which are short lived, because the newly planted trees compete with the old trees and reduce their yields.

19. *Diseases*—(i) *Bud-rot.*—This is the most serious fungus disease of the coconut. Often an attack results in the death of the tree, unless it is treated in the very early stages of the attack before the tender growing point is affected and gets completely rotten emitting a characteristic fetid odour. During August and September, after the heavy south-west monsoon rains, when conditions are optimum for the prevalence of the disease, trees should be frequently examined. The first symptoms of the disease are characteristic round discoloured patches on the young leaves of the crown. All affected portions of the crown should be cut, removed and burnt and the crown sprayed with 1 per cent Bordeaux mixture. Trees killed by the disease should be cut and burnt to avoid the spread of the disease to healthy trees.

(ii) *Shoot-rot.*—This disease is common in young palms. The leaves begin to rot from the tip downwards and at times the rot extends to the central bud. This can be controlled by cutting off the diseased portions and spraying the crown with 1 per cent Bordeaux mixture. Shoot-rot is most probably a deficiency disease and application of potash manures helps in reducing the incidence of the attack.

(iii) *Fruit-fall or Mahali disease.*—This disease is very bad in arecanut palms and sometimes it affects coconut trees growing in the midst of areca palms. The nuts rot and drop from the bunches. The disease can be prevented by spraying the bunches with 1 per cent Bordeaux mixture before the setting in of the south-west monsoon followed by another spraying in July-August.

(iv) *Stem-bleeding disease.*—From the trees attacked by the disease, a dark red liquid is seen oozing through cracks in the trunk. The inner tissues rot and in bad cases the tree dies. In the early stages of attack the affected parts of the stem should be completely scooped out with a chisel and crude oil or tar applied to the cut surfaces. The disease is rather severe in soils lacking proper drainage. In such places drainage should be improved by opening proper drainage channels.

20. *Pests*—(i) *The Rhinoceros beetle* (*Oryctes rhinoceros*).—The rhinoceros beetle is one of the most destructive pests of the coconut palm and is very common all over the coconut tracts. The adult beetle attacks the crown, boring into the tender parts. Young flower bunches and leaves are damaged with the result that yield of nuts is considerably reduced. The damage to young trees is some times very severe. The place of attack can be located by the presence of lumps of chewed material pushed out of burrows in leaf axils. The trees should be frequently searched and the beetle extracted from the burrows by piercing it with a sharp thin iron hook with a recurved tip about 2 feet long, and killed. Filling of leaf axils with sand is said to reduce the attack. As the beetle generally breeds in large numbers in manure and compost pits and rubbish heaps, these places should be searched at least once a month for the large fleshy whitish grubs, which should be collected and destroyed.

(ii) *Black-headed caterpillar* (*Nephantis serinopa*).—This caterpillar pest of the coconut though sporadic causes serious damage in certain years. In South Kanara, thousands of acres of coconut gardens are affected periodically and serious damage is caused. The pest appears in large numbers and eats away the leaves leaving the mid-ribs bare. Badly attacked trees present a burnt up appearance. The caterpillar thrives in large numbers in webbed galleries on the under surface of leaflets. All attacked leaflets and in severe cases the entire leaves should be cut and burnt so as to destroy the pest. The pest can also be controlled biologically by the timely liberation of a parasite.

(iii) *White-ants.*—White-ants cause serious damage and death to transplanted seedlings particularly in the early stages. The nut of the seedlings and the base of the shoot are attacked. It is difficult to detect the trouble until the seedlings show signs of withering when it is too late to save them. It is therefore necessary to take precautionary measures to avoid white-ant attack. This is best done by covering the nut of the seedling all round by a layer of sand instead of ordinary soil. As a deterrent, crude oil emulsion may be applied at the rate of one pound in ten gallons of water. The treatment may be repeated when necessary till the transplanted seedlings are well established. It is also advisable to search for white-ant hills and destroy the queens.

Co-operative action in combating pests and diseases is much more effective than isolated individual effort.

main crop can be force sprouted by chemical treatment and used for second crop. The seed harvested from the second crop in December-January is used for main crop in March-April. The main crop seed harvested in August-September is stored for 5 or 6 months and utilized for planting the irrigated crop in January-February. While the cultivators adopt a seed rate 1,000 to 1,600 lb. of tubers per acre consisting of tubers weighing $\frac{1}{4}$ to $\frac{1}{2}$ oz. (chats), it is found that planting of medium sized tubers weighing 1 to 2 oz. which requires about 2,000 lb. of seed per acre has given increased yields ranging from 100 to 150 maunds of 25 lb. each per acre.

Cultivation.—The practices followed at the Agricultural Research Station, Nanjanad, where major portion of cultivation is carried out by bullock power, are described below. Two deep ploughings are given with " Victory " plough. Cattle manure at the rate of 4 to 5 tons per acre is applied broadcast and covered with monsoon plough. Furrows are opened by double mould-board plough at 2 feet 3 inches apart almost on contour. This allows surface water to flow away slowly and tends to prevent surface wash as found in the ryots method of planting along slopes. One thousand six hundred and ten pounds of artificial fertilizer (consisting of a mixture of 500 lb. of groundnut-cake, 200 lb. of sulphate of ammonia, 350 lb. of steamed bone-meal, 336 lb. of concentrated super-phosphate and 224 lb. of sulphate of potash) known as Nanjanad mixture is applied on the furrows. The seed potatoes are then covered by splitting the ridges with a double mould-board plough. The handy andy cultivator is worked within ten days after planting with a small plank tied across the rear end of the implement to knock off the tops of ridges thereby killing of germinated weeds and saving hand weeding. The potato sprouts then come through quickly. The same implement without a cross plank is used again whenever the weeds are found coming up in the furrows until the first earthing up. Two earthings up are given, first when the plants are 6 to 7 inches high and the second just before the crops covers the drills. Deep earthing up is practised in wet weather in order to prevent the potatoes in ridges from being effected by excessive moisture. With

rows close together, the ryots cannot earth up deeply and this probably one of the reasons why they plant up and down the slope as a greater percentage of excess rain disappears as surface run off. Soil wash is however excessive with the ryots method. The crop matures in 3 to 5 months depending upon the variety and age of seed used. The haulms completely die down when the crop is ready for harvesting. The crop is lifted by potato digger plough and the tubers are gathered, allowed to dry and graded into table, medium, chats and rejected. An average yield of 10,000 to 12,000 lb. of tubers per acre can be expected.

Pests and diseases.—The most important pests and diseases are briefly mentioned below :—

Cut worms.—(*Euxoa sp.*) are most serious pests causing damage by cutting down haulms. The use of D.D.T. and gammexane has been found effective in controlling this pest.

Potato moth.—(*Phthorimea operculella*) attacks tubers both in the field and store. By deep earthing up in the field and the use of light traps in the store, the damage can be prevented.

Plant lice attacking young sprouts in seed store can be checked by spraying with tobacco decoction.

Ring disease.—(*Bacillus solana cearum*) causes the whole plant to wilt and die suddenly. Use of disease free seed and disease resistant varieties and avoiding water-logged places are recommended.

Early blight.—(*Alternaria Solanii*)—causes pale brown spots scattered irregularly over the leaf resulting in low yield. Use of seed not more than 3 months old and spraying with Bordeaux mixture prevents the disease.

Besides the above pests and diseases, rats, pigs and porcupines cause considerable damage by digging out and eating tubers. Rats can be controlled by rat-traps and poison baits. Fencing with wire-netting, building stone dykes and digging trenches along boundary keep away the other two animals.

Results of research.—Research work on potato crop is being carried out at the Agricultural Research Station, Nanjanad. The results of experiments have conclusively proved—

(1) that planting in ridges along contour is better than local method of planting in slopes;

(2) that the economic seed rate to be adopted is to plant medium sized tubers weighing 1 to 2 oz., 6 inches to 9 inches apart in rows 2 feet 3 inches apart;

(3) that freshly sprouted 2 to 3 months old seed is better than 8 months old seed;

(4) that Nanjanad mixture is superior to other manure mixtures;

(5) that freshly harvested seed force sprouted by treating with carbon-bi-sulphide is as good as naturally sprouted seed for planting;

(6) that cultivation of green manure crop like blue lupins maintains the yield of potato;

(7) that it is advantageous to raise a green manure crop in the second season instead of leaving land fallow; and

(8) that composts made from green organic matter was equivalent to cattle manure in manurial value.

Conclusion.—Further information or advice on this crop can be had from the nearest Agricultural Demonstrator or from the Superintendent, Agricultural Research Station, Nanjanad, Ootacamund P.O.

K. HANUMANTHA RAO,
Superintendent.

GOVT. PRESS, MADRAS.

SOME QUICK GROWING FUEL TREES

Perhaps at no other time in the history of our country has the problem of fuel and food supplies become so complex as it stands today.

Today we are meeting with the deficit not only in respect of food but also of every other important necessity of life such as firewood, coal, clothing, etc. This state of affairs cannot be allowed to continue as it will lead to the Nations' ruin. We have therefore to explore all possibilities of increasing the output of fuel. In this note the fuel problem is considered. The war was responsible for a good deal of deforestation. It is easy to cut down forests to meet immediate necessities but it is another thing to develop forests. The forest department is tackling this problem to the best of their abilities. Then how best an agriculturist can help to solve this problem is discussed here.

It is known that in the villages mostly a good portion of cow-dung (nearly two-thirds) is being burnt as fuel. Cow-dung which has got a good manurial value and also the readily available manure with our ryots is being wasted as fuel. Thus if we have got some alternate fuel a great amount of this dung can be kept for manurial purposes for our crops.

The alternate fuel is got by growing some good quick growing fuel trees. The essential qualities that should be considered in making selection for planting of fuel trees are but a few and therefore make this task very easy. The first principle that should be considered is that the tree selected should be hardy and of quick growing nature. Their value as fuel to a very great extent depends on the calorific value they possess. In addition the trees selected should lend themselves to frequent prunning and burn with least difficulty. Their capacity to resist against natural diseases and pests and adverse climatic considerations and draught should never be forgotten. A proper selection made bearing all these objectives in view is bound to make a suitable tree for planting for fuel which will be at our hands in a short period.

Being fairly conversant with the growing of the fuel problem and the multitude uses of tree planting a list of trees tried and found promising is given below. As it is not possible to deal with a very comprehensive list of these in the course of a small leaf-let the more important ones among them are dealt giving brief accounts of their respective characterestics, adaptations, local names. These trees not only provide us with the fuel but are also useful to us in so many other ways like giving green manure, protecting the soil from erosion, serving as avenue trees, giving timber, shade, protection as hedges, wind breaks and at the last fodder for the cattle also.

LEGUMINOUS GROUP.

1 *Acacia arabica*, Willd. Black babool. Tam.—Karuvaelam. Tel.—Toomma. Mal.—Karuvalakam. Kan.—Barbara.	Easily raised from seeds and can be grown in waste lands, tankbeds and tank bunds. Specially suited for heavy soils. Gives excellent fuel.
2 *Acacia leucopholea*, Willd. White babool. Tam.—Velvaelam. Tel.—Tellatoomma. Mal.—Vellavelakam. Kan.—Bilijali.	Very much like *A. arabica*, capable of thriving in all soils. The tree should be protected from goats. The pods are valuable cattle food.

3	*Acacia planifrons*, W. & A. Umbrella tree. Tam.—Kudai. Tel.—Budda Tumma. Kan.—Odejali.	A very hardy plant. Good for all dry places especially for sandy dry areas along the coast.
4	*Acacia decurrens*, Willd. Green wattle or common wattle. Tam.—Semaivelamattai.	*Wattles.*—These are suited for higher elevations and give excellent fuel. Can be grown in Wynaad, Nilgiris, Shevaroys and Upper Palanis, etc.
5	*Acacia dealbata*, Link. Silver wattle or white wattle. Tam.—Semaivelambattai.	
6	*Acacia melonoxylon*, R. Br. Black wattle. Tam.—Semaivelambattai.	
7	*Adhatoda vasica*, Nees. Tam.—Adatodai. Tel.—Addasaram. Mal.—Atalotakam. Kan.—Adusoge.	A dense shurb, quick growing comes up in all soils. Easily propogated by cuttings. Leaves and roots are of medicinal value.
8	*Adenanthera pavonia*, Linn. Barbadose pride. Tam.—Anaikunrimani. Tel.—Badigurivenda. Mal.—Mahicati. Kan.—Manjudi.	The tree is easily raised from seed. Fit for planting in waste lands, prombokes tank and river bunds, comes up in all soils.
9	*Azadirachta indica*, Juss. Tam.—Veepamaram. Tel.—Vepa. Mal.—Aryaveppu. Kan.—Nimba.	Universally known. Cultivated and wild very well suited for all soils. Raised from seeds.
10	*Bauhinia racemosa*, Lam. Tam.—Malai athi. Tel.—Ari. Kan.—Banne.	A small deciduous tree ; gives good fuel. Inner bark gives fibre which is good for ropes, etc. Comes up very well in rocky places. Leaves are useful as fodder.
11	*Cassia auriculata*, Linn. Tanners' cassia. Tam.—Aviram. Tel.—Meraka tangedu. Mal.—Aviram. Kan.—Avarike.	A fast growing shurb, easily raised from seeds, can be grown in all waste places, especially on tank bunds and river banks. Suited for all soils. The bark is useful for tanning purposes.
12	*Cassia siamea*, Lamrk. Sumatha senma. Tam.—Manja konnei. Tel.—Simatangedu. Mal.—Monnakonna. Kan.—Hiretangedi.	One of the fast growing trees with abundant dark green foliage and pretty yellow flowers. Comes up splendidly on road sides, river banks and tank bunds. Raised from seeds, suited for all soils and dry conditions.
13	*Casuarina equisetifolia*, Forst. Casuarina. Tam.—Savukkumaram. Tel.—Sarugudu or saraku. Mal.—Cabakku. Kan.—Cabaku.	A tall tree yielding valuable fuel, very good for coastal tracts and canal bunds. First nursery should be raised and then seedlings are transplanted. Requires watering in the earlier stages.

14	*Delonix eleta*, Gamtd. Pea-cock flower tree. Tam.—Vathanarayanan. Tel.—Chettikesavaram. Kan.—Sunkesari.	A quick growing tree with a spreading doom forming habit. Best suited for dry areas. Propagated easily by cuttings. Can be grown along hedges, road sides, manure-pits, etc. Requires very little care, but has to be protected from animals.
15	*Enterolobium saman*, Prain. Rain tree. Tam.—Thoongamoonji maram. Tel.—Nidraganneru.	A pretty large-sized quick growing tree. Easily raised from seeds. Suitable for all soils. Best planted along road sides.
16	*Gliricidia maculata*, Hb and K. Madri. Tam.—Seema avarai. Tel.—Nagarakesari.	A quick growing tree, easily raised from seeds or cuttings. The twigs are very useful as fuel and leaves as green manure. It is capable of being grown in any soil with a little care and watering.
17	*Hibiscus tiliaceus*, Linn. Corkwood bendy. Tam.—Malampoovarasu. Tel.—Seeagogu. Mal.—Nirpartti.	A medium sized tree, drought resistant, can be raised by cuttings. Best suited for coastal areas.
18	*Jatropha curcas*, Linn. Punging nut. Tam.—Kaataamanakku. Tel.—Peddamepalem. Mal.—Kattavanakku. Kan.—Adaluharalu.	A useful shurb often growing along hedges-branches burn even when not fully dried. Easily propagated by cuttings and comes up well under all soil and climatic conditions.
19	*Kydia calycina*, Roxb. Tam—Vendai. Tel.—Velukku. Mal.—Belagu benda.	A small quick growing tree, drought resistant, can be raised in hard rocky soils. Leaves relished by cattle.
20	*Leucaena glauca*, Benth. West Indian bed tree. Tam.—Savundal. Tel.—Kaniti. Mal—Takaramniram.	A quick growing tree with hard branches. Easily raised from seeds and comes up in all soils.
21	*Parkinsonia aculeata*, Linn. Jerusalem thorn. Tel.—Simatumma and simajuluga.	A small tree, comes up very well in black cotton soils and heavy soil areas near tank bunds and wet tank beds. Can be grown as hedge plant.
22	*Peltophorum ferrugineum*, Benth. Tam.—Iyalvagai. Tel.—Kondacinta.	An exotic beautiful tree. Easily raised from seeds. Requires a little care in the early stages.
23	*Pithecolobium dulce*, Benth. Madras thorn or Mannilla tamarind. Tam.—Kattuppuli, Koddukupulli. Tel.—Sincinta. Mal.—Kurkkampuli. Kan.—Cakli.	A large tree. Can be raised easily by the seeds. Grows rapidly and gives good fuel. Fruits are edible and comes up in all soils.

24 *Prosopis [illegible]flora*, Dc.

The plant was introduced from America; it is best fitted for being raised in hard stony or laterite soils, very drought resistant and easily raised from seeds. The pods are valuable as cattle feed.

25 *Sesbania grandiflora*, Pers.
Tam.—Agathi.
Tel.—Avisc.
Mal.—Ahatti.
Kan.—Agase.

Another quick growing tree having an upright growth often cultivated as standards for betel vines, easily raised from seeds. The tender leaves are relished in curries; also a good fodder. The fuel though not as good as that of *Casuarina* or *Odesia Siamea* is obtained within 2 years of planting.

26 *Thespesia populnea*, Can.
Tulip tree, Portia tree.
Tam.—Poovarasu.
Tel.—Gangaravi.
Mal.—Puppamatti.
Kan.—Bengali.

This tree is common all over the province and raised from cuttings. Valuable as green manure also and hence can be grown around back-yards manure pits, roadsides, etc.

S. N. CHANDRASEKHARAN,
Systematic Botanist, Agricultural College and Research Institute, Lawley Road P.O., Coimbatore

MADRAS: PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS.

LEAFLET No. 17]

Some Avenue Trees

The importance of avenue trees is well known to everyone and it is superfluous to make mention about the need for their planting on road sides. Well grown trees on either side of a road lend a picturesque view, shed a grace and give character to the roads. There are many majestic trees which meet the eyes at different levels by their magnificent growth and exquisite beauty. When the trees flower and become laden with them they please the eye and make the roads enchanting. Avenue trees are mainly for the purpose of giving shade and beauty to the road and also helping in preventing soil erosion. Sometimes trees which have an economic value like the tamarind, the mango, the sapota, etc., are also planted as avenue trees in which cases they must be specially cared for as there is likelihood of their being mutilated by people who steal their products.

Trees can be easily established if proper thought is given in selecting the plant for the locality. In selecting avenue trees the following points have to be kept in mind (1) the long lived nature (2) drought resistence (3) a capacity to adapt to the different kinds of soils and (4) a fairly deep root system. The selected plants must be raised carefully in a nursery and only after they have developed into healthy plants they should be transplanted as avenue trees.

A list of trees with their common names and equivalents in local languages is given hereunder with short notes on the method of their propagation. Any further information required can be had from the Government Lecturing and Systematic Botanist, Lawley road P.O. Coimbatore.

Botanical name.	*Common name.*	*Remarks.*
3. *Ficus carica.*	Fig. *Tam :* Atthipazham. *Kan :* Anujura or Anjum.	Generally speaking a dry locality seems best for the fig, provided there is ample water supply. Dry atmospheric conditions are believed to be specially necessary at the time of fruit development and maturity. The soil best suited for the fig seems to be that of medium to heavy nature, retentive of moisture, but well drained. Like the grapes the fig is commercially propagated by cuttings which are generally taken from mature one year old wood during a dormant season.
4. *Fragaria vesca.*	Strawberry.	This is grown commercially on elevations exceeding about 4,000 feet above the mean sea level in South India and more particularly between a range of 5,000 to 7,000 feet. The strawberry is propagated either by runners or splits from the clumps. The splits or runners from healthy and prolific yielding plants are palntedout either as an inter crop in fruit orchards or a pure crop.
5. *Morus sp.*	Mulberry.	Though generally classed as a temperate zone fruit, it is found to grow well on a wide range of climatic conditions in South India. The propagation is done mostly by cuttings though it is possible to do with seeds also.
6. *Passiflora edulis.*	Passion fruit.	The vine can be raised by seed or cuttings. Since the seeds germinate slowly cuttings are generally preferred. The vines are grown on trellis or fence.
7. *Prunus salicina.*	Plum.	The Japanese plums have been found to be most prolific and very remunerative at elevations ranging from 4,500 feet to 5,500 feet in South India but outside this range they are not dependable. The plum is propagated at Coonoor on year old common peach seedling rootstock, by budding.

Botanical name.	*Common name.*	*Remarks.*
8. *Prunus persica.*	Peach.	Generally speaking that part of South India lying between 4,500 and 6,000 feet elevations may be deemed to provide the most favourable conditions for peach. In Bangalore grafting of the peach on plum was common but now layering is largely practised.
9. *Physalis peruviana.*	Cape goose berry.	A small shrub found to grow both on the hills and the plains of South India, in the former case up to an elevation of about 6,000 feet from the mean sea level. The propagation is by seeds. The seedings are transplanted in rainy seasons, when about 6″ to 8″ high into permanent sites either as inter crop in orchards or as pure plantations.
10. *Punica granatum.*	*Tam :* Pomegranate. Madalamkai.	It is found to grow and fruit well all over the plains and even on the hills up to an elevation of about 6,000 feet. It seems well adapted to diverse soil types though heavy loams are preferable. The almost universal popular method is to raise this fruit by hard wood cuttings.
11. *Pyrus malus.*	Apple.	The apple relishes a deep soil uniform texture, preferably of a loamy nature above 5,000 feet altitude. Good soil drainage appears very beneficial to apple growth and production and this has to be provided for, regardless of soil depth. Propagated by grafting. The whip and tongue methods are adopted.
12. *Pyrus communis.*	*Tam :* Pear. Berikai.	The pear is more widely grown in South India and is more popular among the general public. The common method of raising pears on Nilgiris is by grafting by whip and tongue method on rooted stock pear cuttings.

Serial number and Botanical name.	Common name.	Vernacular equivalents.	Remarks with hints on propagation.
14 *Polyalthia longifolia, B & H.*	Indian Mast tree Asoca.	Tam. Nettilingam; Tel. Asokamu; Kan. Putrajivi; Mal. Aruna, Asokam	A symmetrical tree ideal for avenues. Adapted for all kinds of soils.
15 *Spathodea campanulata, Beauv.*	Fountain tree	Tel. Patade; Kan. Nirukaye	A conspicuous tree which thrives well up to 4,000′. Common in plantations.
16 *Syzyglum jambolanum, Dc.*	Black plum	Tam. Naval, Nagai; Tel. Jambuvu; Kan. Jambunerale, Nerale; Mal. Naga	An economically important medium sized tree which forms a good avenue tree. Bears purple coloured fruit. Propagated by seeds.
17 *Tamarindus indica, L.*	Tamarind	Tam Puliyamaram; Tel. Amblica; Kan. Hulimaram; Mal. Puli	A common tree suited well for avenues, readily propagated by seeds. Tamarind of commerce. Medically useful—wood used for fuel.
18 *Terminalia Arjuna, R. B.*	White Murdah	Tam Vellaimarudu; Tel. Tella maddi; Kan. Arujan, Bilimatti; Mal. Vellamaruka	A large sized tree commonly grown on road sides. By seeds.
19 *Thespcsia Populnea, Cav.*	Tulip tree	Tam Poovarasu; Tel. Kangarai; Mal. Poovarasu; Kan. Jogirale	An evergreen quick growing tree suitable for avenues which comes up well near coasts—propagated by cuttings—fuel.

MADRAS: PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS.

Hill Fruits

Introduction :—Fruit growing is recognized to be among the most fascinating of rural avocation. It is now universally recognized that man cannot live on agricultural produce alone. He requires a variety in diet and supplementary foods of certain health giving properties as the fruit.

Most of the agricultural crops are seasonal and the ryot requires, therefore, other diversified avocations to engage himself profitably in slack periods. Unlike general agricultural farming fruit growing provides little leisure and no slack periods. The diversification and all the year round work which fruit growing provides are especially and obviously necessary to the social and economic development of South India.

Nature has richly endowed South India with a fruit wealth of great and almost unrivalled interest, diversity and character. South India has everything in its favour to develop fruit production, such as to be an inspiration even to the rest of the world.

South India is blessed with a very richly diverse climate, which favours the production of almost every fruit.

Primarily a region suited to tropical and sub-tropical fruits, South India is recognized to be outside the ideal zone for the production of fruits of the temperate region. Owing to the modifying influences of altitude, however, endeavour has been made to raise most of the temperate zone fruits with success. Topography rather than latitude as determined by temperate ranges, rainfall, elevations and soil rather than geography should be the standards in delimiting the optimum fruit zone in South India. Accordingly the designation of 'Hill fruits' is considered more appropriate for the fruits commercially cultivated on South Indian Hills.

A list of fruit trees suitable for cultivation on hills are given here Further information on this subject may be got from the Lecturing and Systematic Botanist, Lawley Road P.O., Coimbatore.

Botanical name.	*Common name.*	*Remarks.*
1. *Cyphomandra betacea.*	Tree tomato.	A short statured highly ornamental tree with oblong fruits produced in beautiful clusters, the tree tomato is popular on the hills of South India. The propagation of tree tomato is by seed as well as cuttings.
2. *Diospyros kaki.*	Persimmon.	Though classed as a sub-tropical fruit, the persimmon is found to thrive well at Coonoor along side the plum, peach and hardy varieties of apple and strawberry. Propagation is by grafting or budding on other species of Diospyros.

Botanical name.	*Common name.*	*Remarks.*
3. *Vitis vinifera.*	Grape. *Tam:* Drakshai pazham. Kodi mundri pazham. *Tel:* Drakshapandu	Grape is generally considered to be a commercial fruit of the temperate zone but experience in viticulture in South India has proved that the yields and the quality of grapes produced in certain situations under tropical conditions of South India are in no way less than those reported from what are usually considered as the ideal homes of the fruit. A deep well drained loam is considered the best medium for the crop in South India. For commercial cultivation grape is universally propagated by cuttings and usually planted from June to January.

Humid Zone Fruits.

1. *Dario zibethinus.*		Being a humid tropical fruit it is at home on rich soils with ample moisture at the roots and on sites enjoying a high relative humidity and long growing season. Propagated by seeds, seedlings are transplanted 30 feet to 40 feet apart.
2. *Garcinia mangostana.*	Mangosteen.	A rich loamy soil of good drainage but with ample soil moisture supply is also necessary for the success of this crop. This can be cultivated on the hills and hill slopes from about 1,200 feet to 3,500 feet provided the annual rainfall is over 50" and the sites are well sheltered by thick vegetation. The most common method of propagation is by seeds.
3. *Lansium domesticum.*	Langsat.	This is grown as stray trees. The fruits are borne in clusters from April to September. The trees are propagated by seeds.

Botanical name.	*Common name.*	*Remarks.*
4. *Litchi chinensis*	Litchi.	The litchi seems to prefer a fertile, medium to open texture and deep soil with ample organic matter and water supply; but it is essential that the soil should be well drained. Layering and gootee are the common methods of propagation, but grafting and budding have also been reported as possible.
5. *Monstera deliciosa.*	Monstera.	It is a semi-creeping ornamental plant that can be grown particularly, in humid slopes as well as in sheltered spots all over the plains. It is commonly trained on a large tree. The plant is propagated by stem cuttings or seeds.
6. *Persea americana.*	Avocada pear.	Its climatic and soil requirements seem to conform to that of mangosteen, loose jacket orange and litchi in South India. The avocado can be raised from seed and some have reported that the seed progeny of certain varieties are uniform. It is however safer to adopt vegetative propagation using the seedlings as root stocks, if necessary.

MADRAS: PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS.

Fruit Trees of the Plains

Introduction.—Fruit growing is recognised to be a fascinating rural avocation. It is now universally recognised that man cannot live on agricultural produce alone. He requires a variety in diet and supplementary foods of certain health giving properties as the fruits.

Most of the agricultural crops are seasonal and the ryot requires, therefore, other diversified avocations to engage himself profitably during slack periods. Unlike crop husbandry, fruit growing provides little leisure and no slack periods. The work is diversified and spread over all the year round.

Nature has endowed South India with a fruit wealth of great and unrivalled interest, diversity and character. South India has everything in its favour to develop fruit production.

South India is blessed with a very richly diverse climate, which favours the production of almost every kind of fruit.

A list of fruit trees and shrubs suitable for cultivation in plains is given. Further information on this subject may be got from the Lecturing and Systematic Botanist, Lawley Road, P. O., Coimbatore.

Botanical Name.	*Vernacular Name.*	*Remarks.*
1. *Achras Sapota* (Sapota)	*Tam :* Shimai eluppai. *Tel :* Simappa. *Kan :* Kumpole.	The sapota is one of the most adaptable of the tropical fruits and has been found to thrive under a diversity of soil and climatic conditions up to an altitude of about 4,000 feet from the mean sea level. There are indications however, that the trees crop better at the elevations lower than 1,500 feet. In respect of soil it prefers a sandy loam. Layering, gootee and inarching are the common methods adopted for propagation. Layering is popular since it is easy and least expensive. Of late inarching is gaining much popularity.
Aegle Marmelos (Baol)	*Tam :* Vilvam. *Tel :* Bilvapandu. *Kan :* Bilpatri. *Mal :* Kuwelapazham.	A thorny tree found in dry forest areas and occasionally grown in orchards for its ripe fruits. The trees flower from July to August and the fruits ripen in 8 to 9 months thereafter. The yield may be 200 to 800 fruits per year. The tree is raised from seed and it bears in about six years.

Botanical Name.	Vernacular Name.	Remarks.
3. *Anacardium occidentale.* (Cashew)	*Tam :* Mundri. *Tel :* Jidimamidi-vittu. *Kan :* Gerbija. Parankimavu-kuru.	Even though it is possible to grow cashew up to an elevation of about 3,000 feet in south India its performance seems at best in the Coastal and inland areas of the plains below 1,500 ′ from mean sea level. Provided the soil is very open and well drained a variation of rainfall from 20 inches to 150 inches does seem to make any great difference. It is a crop that can grow and fruit even on rocky and poor laterite hill slopes, as is found in West Coast. Better growth and yield are found in soils of a loamy texture and good depth. Most common method of propagation is by seeds sown in seed beds or pots and transplanted. Layering and inarching are also successful.
4. *Annona squamosa.* (Custard apple Sugar apple)	*Tam :* Seethapazham. *Tel :* Seethapandu.	It is capable of standing drought better than most fruit trees. Being very hardy, the custard apple can grow even on slightly rocky situations, on sandy coastal areas, laterite hill slopes or in loamy garden soils. The plants are raised by seeds. Recently this is propagated by inarching and grafting. Grafts of custard apple on bulls heart reach fruiting stage quite early.
5. *Ananas* (Pine apple)	*Tam :* Anashapazham. *Tel :* Anasapandu. *Kan :* Anaasuhannu. *Mal :* Kaithachakka.	It can be raised provided good soil, ample irrigation facilities, heavy manuring and good drainage are available. It prefers a well drained soil of fairly open texture. Propagation is largely done by suckers which emerge from leaf axils. It is possible to raise by slips also which grow just below the apple. The propagation by suckers is commercially preferred in as much as it yields in about 18 months.

Botanical Name.	Vernacular Name.	Remarks.
6. *Artocarpus integrifolia.* (Jack fruit)	*Tam :* Pilapazham. *Tel :* Panasapandu. *Kan :* Halon. *Mal :* Chakka.	A rich and deep soil of medium or open texture seems to be the best for the fruit. This can be raised from seed, but inarching is the best and high yielding type on its own seedling root-stock is very popular.
Borassus flabellifer. (Palmyra)	*Tam :* Panai. *Tel :* Tatichattu. *Kan :* Panamara. *Mal :* Pana.	Like the wild date and zizyphus, the palmyra is a hardy plant tolerating even some amount of alkali. The propagation is from seed and the palms produce crops after 15 to 20 years, giving on an average of about 50 fruits per year. The tender fruits are in season from April to May while the ripe fruits are available from July to September.
Carica Papaya (Papaya)	*Tam :* Pappali. *Tel :* Boppayi. *Kan :* Parangi. *Mal :* Pappaye.	Successful papaya production is possible in all parts of South India, excepting on elevations over 5,000 feet above the mean sea level and on sites subject to frosts or frequent cyclonic weather. Though adopted to wide range of soils, the best performance is seen on rich loams of uniform texture up to about six feet in depth. The papaya is almost universally raised from seed.
9. *Carissa carandas.* (Carissa)	*Tam :* Kalaka. *Tel :* Kalikaya. *Kan :* Karekai.	It is found in dry forest areas and occasionally also in the hedges and in the form of individual shrubs in gardens and orchards. This is propagated by seeds.
10. *Syzygium Jambolanum.* (Jaman)	*Tam :* Naval. *Tel :* Nasodu. *Kan :* Narala. *Mal :* Jam.	It is a large tree found in forest areas, fruits are small and edible. The propagation is by seeds.
11. *Feronia elephantum.* (Wood apple)	*Tam :* Vilam. *Tel :* Yellanga. *Kan :* Vel.	This is found in forest regions of dry areas of South India. Its fruits have an edible pulp of fair quality enclosed in a hard rind. Occasionally the tree is grown in orchards as stray trees. It is propagated by seeds.

Botanical name.	*Vernacular name.*	*Remarks.*
12. *Grewia subinaequalis.* (Falsa, Phalsa)	*Tam :* Tadachi. *Tel :* Putiki.	This fruit is relatively a recent introduction, but has been found to thrive easily on the arid and warmer parts of South India. The seeds are sown during the monsoons and the seedlings can be transplanted a year hence. No irrigation is necessary and it can also grow even on relatively poor soils. The seedlings bear fruits in a year or two after planting. Propagation by layering is also found possible.
13. *Phoenix dactylifera.* (Date palm)	*Tam :* Perichankay. *Tel :* Karjurukaya. *Kan :* Karjira. *Mal :* Parikay.	A sub-tropical palm, grows to a height of 60 to 80 feet. The cultivated date relishes a hot and dry climate with ample moisture at the root. Commercially it has to be propagated only by off-shoots or suckers. The wild date produces fruits from April to June in South India (i.e.) before the rains commence. A full grown palm may yield about 12 bunches or roughly 40 lb.
14. *Pithecolobium dulce.*	*Tam :* Korukapuli. *Tel :* Sinnachinta. *Kan :* Sinnahunase.	A popular thorny hedge plant of the dry areas. This yields pods with edible pulp, from April to May. The propagation is by seeds. The pods are borne only when the plants are left untrimmed.
15. *Psidium Guajava.* (Guava)	*Tam :* Koyya. *Tel :* Coyyapandu. *Kan :* Shobehannu.	The best conditions for their plantings are high-lying sandy soil stretches of the river beds or banks where alluvial soils are intermixed with large amount of sand. Any well drained soil of open texture that is not classed as stiff clay, permit guava tree to grow and fruit satisfactorily provided there is at least about 4 feet of soil. Seed propagation is the rule in South Indian commercial plantations, but of late the vegetative propagation of superior varieties by grafting layering or root suckering are becoming increasingly popular.

Botnical name.	*Vernacular name.*	*Remarks.*
16. *Emblica officinalis.* (Amla)	*Tam :* Nelli. *Tel :* Usirika. *Kan :* Nilaka.	The amla tree is ornamental and grows up to an altitude of about 4,000 feet in both arid and humid zones. The tree is propagated by seeds and they reproduce fairly true to the parents by this means. The trees yield fruits from March to July.
17. *Terminalia Catappa.* (Country almond)	*Tam :* Nattuvadam. *Tel :* Kudamvittulu. *Kan :* Natubadami. *Mal :* Kothokuru.	This is also known as the Indian almonds. It is a handsome and large tree of high ornamental value grown in many house compounds. It bears fruits, the pulp of which is edible enclosing a thin kernal which is also eaten with great relish. The propagation is by seed. The fruits are ready for harvest in April-May and again in October-November.
18. *Zizyphus Jujuba.* (Jujube)	*Tam :* Elanda. *Tel :* Rengha. *Kan :* Illangi.	The jujube is not fastidious about soil and is even tolerant to alkali. Amazing adaptability is seen from the fact that trees are found to grow even in water logged sites as well as in the dry areas with water table several scores of feet below the surface and with no artificial irrigation at all. The propagation of jujube is from seed but vegetative propagation of superior varieties by budding is preferred.

19. *Citrus.*—Evergreen shrubs or trees usually armed with spines. The leaves possess winged petiole and oil glands.

Different species of citrus have different climatic requirements for their successful production. Thus, the cultivation of sweet oranges (Sathugudi) in Cuddapah, Kurnool, Chittoor and Batavian in Circars are favoured by the dry or arid conditions prevailing in those parts. Similarly higher elevations and arid conditions prevailing in those parts. Similarly higher elevations and tracts with higher humidity and rainfall such as those prevailing in the Wynaad and Agency tracts and parts of Nilgris and Salem districts favour the production of loose jacket or mandarin (Kamala) oranges.

A loamy soil of good fertility and of uniform texture to a depth of about 8 feet with water table at 8 feet level at all times of the year is best suited for successful commercial production of citrus. Alkaline soils are to be avoided.

Commercial citrus species of South India are as follows :—

Citrus sinensis—Sweet Orange—Sathgudi—Bathai.

Citrus reticulata—Mandarin (tangerine—Kamala or loose skinned orange, *Kan :* Kittale hannu.)

Citrus aurantifolia—Lime. *Tam :* Elumichampazham.
Tel : Nimmepandu.
Kon : Nimbehannu.
Mal : Erumitchi narracum.

Citrus lemon—Lemon. *m :* Periya elumichampazham.
Tel : Peddanimma pandu.
Mal : Acherunaranna.
Kan : Dodda nimbe hannu.

Citrus grndis—Pummelo. *Tam :* Bombalimas.
Tel : Edapandu.
Kan : Sakotra hannu.
Mal : Bombeli marunga.

Other citrus varieties are Jamberi, Gajanimma, Sour orange, etc., These are commonly propagated by budding on Rough lemon (Jamberi) root stock but in the case of lemon, layering is vey popular.

The season of cropping in the different species of citrus is as follows :-

Sathgudi :—

a. Main crop—November-March.

b. Second crop—June-November.

c. Third crop (occasional)—March-June.

2. Batavian—July to December.

3. Loose jacket Orange.

a. Main crop—December-April.

b. Off-season—July-September.

4. Limes—All the year round with maximum productions confined to certain months (December to January and February to May.)

20. *Mangifera indica*. *Tam :* Maa.
Tel : Mamadi.
Kan : Mavu.

A large spreading evergreen tropical tree with dense shining leaves.

It grows up to an elevation of 4,000 feet above mean sea level. The mango grows in a variety of soils. Mango cannot thrive under water-logged, alkaline, entirely rocky or very shallow conditions of the soil. For successful commercial production of this fruit it is always good to select a loamy soil of good depth.

There are over 350 varieties under cultivation. The commercial varieties of our state (Madras) are Neelum, Bangalora, Rumani, Banganapalli or Baneshan, Chinnaswarna-rekha and Olour. Success in mango growing demands the selection of varieties which will be productive and regular bearing in a particular tract. The regional varieties of mango are as follows :—

Tamilnad :—Padiri, Peter, Neelum, Bangalora, etc.

West Coast—Olour, Mundappa, Alphonso (Khader) etc.

Central districts—Alphonso (Khader or Gundu), Peter (Nadusalai) Bangalora, Rumani, Baneshan, etc.

Rayalaseema—Rumani, Neelum, Swarnarekha, Banganapalli (Banseshan), Bangalora, etc.

Circars—Swarnarekha, Cherkurasam, Kothapalli kobbari, Panchadara-kalasa, Baneshan, etc.

The mango is commercially propagated by inarching the best and prolific varieties on its own seedling root stocks.

Most of the varieties come to bearing in about the fifth year of planting and they are in season from February to May in West Coast and in other parts of the State from April to July. The off season cropping is from December to January.

MADRAS : PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS.

Green-Leaf Manure Yielding Plants And Trees

Green manuring and green-leaf manuring have been practiced by the farmers of India and all over the world for more than 2,000 years. But in the present century the problem has been brought to limelight by agricultural scientists. The terms 'green manuring' and 'green-leaf manuring' convey technically different meanings though the ultimate object is the same in both cases. The practice of lopping green leaves from trees like pungam, neem, etc., and applying them to paddy fields is called 'green-leaf manuring', while crops like Pillipesara, Daincha, Sunnhemp and Indigo raised in a field and ploughed 'in situ' is termed 'green manuring'.

For improving the conditions of the light sandy soil, especially, the application of green-leaf as manure is of greatest value. In the case of heavy clay soils drainage facility is improved. The principal benefits derived are (i) the addition of humus to the soil which increases the capacity for retaining water; (ii) the prevention of erosion of surface soil in undulating rainfed soils; and (iii) the fixation of atmospheric nitrogen into the soil by leguminous green manure crops.

While practically all plants are useful for adding organic matter to the soil certain plants are more valued and leguminous plants have the power of fixing the 'free' nitrogen from air into the soil. The trees utilized for the purpose should be quick growing with plenty of foliage and withstand pruning well.

In some cases trees can be actually grown around every field and along the banks of water channels.

Green-leaf manuring.—There are various trees whose leaves are suitable for green-leaf manuring. For example, 'Gliricidia' is a very quick growing one which can be lopped when the tree is about 3 years old. Similar trees, yielding good foliage can be raised for supply of green-leaf manure.

Green manuring.—This method is not as easy as the other one as it is controlled by many limiting factors; since the crop has to be raised right in the cultivated field itself. Dhaincha and Indigo, etc., have been found to be good.

Such of those trees and plants which are suitable for our Province to be used as green-leaf manure or green manure are listed below with their vernacular names and other useful information. Any further information on the subject can be got from the Government Lecturing and Systematic Botanist, Lawley Road P.O., Coimbatore:—

Green Manure Plants

1. *Cassia tora.*—*Tam*: Tagarai. *Tel*: Tantipu
   Mal: Takara. *Kan*: Tayanku.

An annual almost an under-shrub grows wild in all waste places up to 4,000 feet. Easily raised by means of seeds. Seeds being sown at the rate of about 15 lb. per acre. Leaves may be cut just before flowering.

2. *Cassia occidentalis.*—*Tam*: Payavarai. *Tel*: Cashandra. *Mal*: Natramtaraka. *Kan*: Ananta janken.

A diffuse shrub grows wild along roadside and waste places, produces seeds in plenty and gives plenty of foliage. Can be easily raised by seeds; a seed rate about 15 to 20 lb. per acre may be adopted. Leaves may be cut just before flowering.

3. *Crotalaria verrucosa.*—*Tam*: Ghilugillippai. *Tel*: Gholendherinta.

A much branched herbaceous annual comes up under saline conditions also. Raised by seeds. Green leaf may be available for cutting when two and half months old.

4. *Crotalaria juncea.*—*Tam*: Sanappai. *Tel*: Shanama. Sunnhemp. *Mal*: Sanam. Vakku. *Kan*: Henna. Sanabu.

A very common green manure crop grown throughout India. It is adapted to lighter soils and lands with easy drainage. Chiefly used as a green manure for rice but grown as a good fodder crop also. It can be easily raised by seeds; 30 to 50 lb. of seed being required to sow an acre. It can be grown in paddy fields and in dry lands under rainfed conditions also, and when two to two and a half months old (just before flowering) the green leaf may be cut and applied to the fields. It is grown as a rainfed as well as an irrigated crop.

5. *Crotalaria striata.*—*Tam*: Peria gilugiluppai.

It is a herbaceous shrub growing to about 3 to 4 feet in height which can be easily raised by seeds, seed rate being 30 to 40 lb. It is very much suited to plains especially to West Coast where it is found to occur wild, this is now being introduced in other parts of the State. It is a rainfed crop available for cutting leaves after a period of about three months from sowing.

6. *Calotropis gigantea.*—*Tam*: Erukku. *Tel*: Jilledu. *Mala*: Yerikku.

This is a common and most widespread shrub growing wild all over India. The leaves are available in plenty for cutting at the commencement of the paddy season. In a favourable season, 3 to 4 cuttings may be easily available.

7. *Indigofera endicaphylla.*—*Tam*: Siriya kolingi.

A trailing annual found growing vigorously up to 6,000 feet. Raised by means of seeds. A seed rate of about 20 lb. per acre may be tried. Green leaf may be available for cutting in about 3 to 4 months.

8. *Sesbania aculeata.*—*Tam*: Nirchembai. *Tel*: Erraijuga. (dhaincha) *Mal*: Kitannu. *Kan*: Mulleyinampi.

It is a herb producing plenty of leaves. Suitable to heavy soils. It can be grown on low wet ground which does not require much preparation as the plant is hardy. It is easily propagated by seed. The seed rate being 15 to 20 lb. per acre. It requires considerable time for growth and hence can be grown in single crop fields only. The time of sowing is after the first showers of April or May. The crop is ready to be cut in about 6 to 8 weeks, i.e. before flowering and applied to fields.

9. *Tephrosia purpurea.*—*Tam*: Kolingi. *Tel*: Vempali. (wild indigo.) *Mal*: Kolunnil *Kana*: Kogili..

A quick growing plant. Can be used as a green manure for paddy. Raised by seeds sown at the rate of 15 lb. per acre. Its growth is rather slow and suitable only for single crop wet lands. The plants have to be cut before flowering. It is a rainfed crop.

10. *Tephrosia candida.*—*Tam*: Periya kolingi. (Boga mediola.)

A perennial shrub coming up well up to 4,000 feet. It can be readily propagated by seeds. It can be planted one foot apart in rows. In about a year or two the shrub is ready for cutting and can be cut four times in a year thereafter.

Green Manure Trees.

1. *Erythrina lithosperma.*—*Tam*: Mulilla murungai. (Dadap.) *Mal*: Mulilla murukka.

A moderate sized spineless tree which is a rapid grower affording good quantity of foliage. Easily propagated by cuttings and should be planted on the same day as they are cut. They can be planted at a distance of 16 feet by 18 feet or 16 feet by 16 feet. At the end of two to three years the tree gives good foliage and can be lopped twice a year and applied to the fields.

2. *Erythrina indica.*—*Tam*: Kalyana murungai. *Tel*: Badila. (Coral tree.) *Mal*: Kalyana murukku. *Kan*: Hongaraka.

It is a tree easily propagated by cuttings. Thel eaves are useful for green manure. Yields plenty of big leaves. Very well suited to all places. Can be planted in hedge rows. Two to three leaf cuttings may be taken in a year. Spacing 12 to 15 feet apart.

Gliricidia maculata.—*Tam*: Peyavaraimaram. (Madre.)

This is a small sized tree grows rapidly and thrives from sea level to 3,000'. Propagated by both seeds and cuttings but easily propagated by cuttings. It is planted at a distance of 10 feet by 10 feet. The leaves may be available for cutting in about two years after planting. Two to three cuttings may be taken per year, but with good rainfall the cuttings may be more.

4. *Hibiscus tiliaceous.*—*Tam*: Nirparthi. *Tel*: Erragogu. (Rose mallow.) *Mal*: Nirparthi.

A most branched tree which yields plenty of leaves comes up well in sandy and coastal areas. Easily propagated by cuttings and seeds can be lopped when well established. Two to 3 cuttings may be available in a favourable season. The trees may be spaced 12 feet apart.

5. *Leucaena glauca.*—*Tam*: Tagrai. *Mal*: Takaramaram. (Lame tore.)

A small quick growing leguminous tree which is specially suited for dry areas. This can be grown both as a shade and green manure tree for coffee. It stands lopping well. Propagation is by seeds. To obtain quick germination, seed should be immersed in boiling water and then allowed to soak for 12 hours the water being allowed to cool. The tree may be planted 12 feet to 16 feet apart. The leaves may be available for cutting after about 2 years. Two to three cuttings may be taken in a year.

6. *Pavetta indica.*—*Tam*: Karanai. *Tel*: Lakkapapida. (Pallet.) *Mal*: Mallikamutti. *Kan*: Nitille.

A large shrub raised by seeds. Thrives in saline areas and poor soils. Spacing 10 to 12 feet. Two to three cuttings of leaves may be taken in a year.

7. *Pongamia glabra.*—*Tam*: Ponga. *Tel*: Kanuga. *Mal*: Punga. *Kan*: Hongay.

A moderate sized nearly evergreen tree. It grows in coast forests and on tidal river banks. In land mostly along streams and river banks in most districts in the hills up to 3,000 feet. Leaves and twigs are cut and applied to fields. Spacing 12 to 15 feet apart. Lopping of leaves can be taken two to three times in a year.

Rhizophora mucronata.—*Tam*: Kandal: *Tel*: Uppoopooma.

This is an evergreen tree, thrives well in backwater. Propagation is by seedlings which grow on the plant itself, and drop off after some time. These trees will give good amount of foliage and loppings. Can be applied to rice fields. The seedlings can be planted 10 to 20 feet apart. About 3 to 4 cuttings of leaves may be taken in a year.

9. *Thespesia populnea.*—*Tam*: Povarasu. *Tel*: Gangarani. *Mal*: Poovarasu. *Kan*: Hoovarasu.

A fairly large evergreen tree which thrives in all soils especially a long sea shore. It is propagated by cuttings and can be planted along hedges. It grows rapidly and two to three cuttings of green leaves may be taken in a favourbale season. The trees may be spaced 12 feet apart.

MADRAS: PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS.

MADRAS AGRICULTURAL DEPARTMENT.

Bendai (*Hibiscus esculentus*)

Introduction.—From the point of view of nutrition and cheapness of production, bendai is one of the most valued of Indian vegetables. It is grown in almost all the districts in the Presidency during one season or another. The chief defect with the crop is that, if sown out of season, it is subject to a number of pests and the yield is very poor. The crop fares best in loamy soils which have received a good dressing of well-rotten cattle manure.

Season.—The season varies in the districts. The most successful season is the south-west monsoon season.

Varieties.—There are a number of varieties depending on the size, duration of the crop, etc. Other than the local variety, the most important varieties are, the American Long Green, Cooper's Long Green, Long Green Improved and Dwarf Green Prolific, which include both the hairy and glabrous types.

Preparatory cultivation.—Being a short duration crop, it is necessary that manure must be in a readily available form for the crop to derive the maximum benefit. Well decomposed cattle manure applied at the rate of about 15 cartloads per acre enhances the yield to a good extent. The field must be thrown into ridges with a ridge plough with a spacing of about 1½ to 2 feet between the ridges before sowing. A dressing of groundnut cake and ammonium phosphate if applied proves useful for the crop.

Sowing.—Seeds are sown on the sides of the ridges on one side with a spacing of 8 inches to 1 foot between the seeds. The field is given a thorough irrigation after sowing. The 'life' irrigation is given about 4 to 5 days later. Gaps have to be filled up as soon as they are evident. Five pounds of seed are generally sufficient to cover an acre.

After cultivation.—Two weedings, given at intervals of about 25 days after sowing, are sufficient to keep the field clean. An earthing up may be given, if necessary with the second weeding. The crop has to be irrigated as and when necessary.

Harvesting.—Harvesting commences after about two months after sowing and lasts for about a month. This is prolonged if there is a second flush of flowers. Picking must be done at the proper stages, as overmature bendai becomes fibrous and useless for cooking.

Yield.—Yield is, as usual, a highly varying factor. It depends mainly on the season, variety and the attention paid to the crop. Under favourable conditions an yield of about 4,000 to 5,000 lb. per acre may be expected.

Pests.—The most serious pest is aphids in the early stages of the crop. As their multiplication is very rapid, they do considerable damage to the foliage, if prompt control measures are not adopted. Spraying with Nicotine Sulphate mixed with soft soap solution is effective. In the latter stages, jassids which harbour on the under surface of the leaves defoliate the crop heavily. These are controlled by dusting with sulphur mixed with six parts of ash. During the flowering time blister beetles damage the flowers. Hand picking of these is the most effective measure of control.

Cost of cultivation per acre :—Pairs at Rs. 4, men at As. 14 and women at As. 7 per day.

	P. M. W.	Rs. A. P.
Preparatory cultivation :—		
Three ploughings ..	6 6 0 ..	29 4 0
Forming ridges and channels and rectifying them ..	1 5 0 ..	8 6 0
		37 10 0
Manuring :—		
Transporting and applying 10 cartloads of farm yard manure ..	1 1 4 ..	6 10 0
Cost of 10 cartloads of farm yard manure at Rs. 4-0-0 per cartload ..	.. ..	40 0 0
		46 10 0
Seeds and sowing :—		
Sowing seed including filling up gaps	0 0 7 ..	3 1 0
Cost of 6 lb. of seed at Rs. 3 per lb. ..	..	18 0 0
		21 1 0
After cultivation :—		
Two weedings at 25 women per weeding ..	0 0 50 ..	21 14 0
Irrigation :—Eight irrigations on the whole—		
Guiding water at 2 men per irrigation ..	0 16 0 ..	14 0 0
Electricity charges at Rs. 2 per irrigation ..	..	16 0 0
		30 0 0

	P. M. W.	Rs. A. P.
Harvesting :—		
Harvesting charges ..	0 0 60 ..	26 4 0
Rent per acre of garden land. On the basis that 2 crops are raised in the same field per year ..	..	50 0 0
Therefore total cost of cultivation per. acre ..	..	233 7 0
Outturn per acre :—		
Yield per acre ..	4,000 lb. ..	
Value of produce per acre at Rs. 12 per 100 lb. ..	..	480 0 0
Therefore net profit per acre	..	246 0 0

U. Narasinga Rao.
Fruit Specialist, Madras.

PRINTED BY THE SUPERINTENDENT GOVERNMENT PRESS, MADRAS.

MADRAS AGRICULTURAL DEPARTMENT

Cucumber (*Cucumis sativus*)

Introduction.—Cucumber is essentially a hot weather season crop. It is usually cultivated in the beds of tanks that are nearly dried up. In South Kanara it is cultivated in wet lands after the second crop of paddy is harvested. The crop does very well in loamy soils.

Varieties.—The two prominent types are the Coimbatore and the South Kanara or Malabar variety. The former is a long type usually greenish or greenish-yellow in colour and the cucumber has to be cooked before it is fully mature. This type cannot be preserved for long after harvest. The South Kanara variety is bigger in size, oblong and with a golden or mottled yellow colour when it attains maturity. This variety can be preserved for a number of months after harvest.

Preparatory cultivation.—After the preliminary ploughings, irrigation channels are formed about 10 feet apart. Then on both sides of the channels, pits, 2′ to 2½′ square and a foot and a half in depth are dug giving a spacing about 7½ feet between the pits in the same row. About two baskets of well-rotten cattle manure and a small quantity of ash is then incorporated into the pits.

Seeds and sowing.—Seeds are sown at the rate of about 6 to 8 seeds per pit on the sides as well as at the centre and the pits are irrigated. About 2 lb. of seed will be sufficient to cover an acre. After the germination is complete, the seedlings may be thinned, if necessary.

After cultivation.—The pits must be kept free from weeds. Generally 2 to 3 weedings are necessary to keep down the weeds. The first weeding is given about a month after sowing and the second after another 30 to 40 days. The interspaces between the pits have to be also cultivated to suppress the grass and weeds. The crop has to be irrigated at weekly intervals, as the crop suffers due to droughty conditions. A top dressing of Ammonium phosphate and groundnut oil cake meal at the rate of 100 lb. and 400 lb. per acre has resulted in increase of yields. The top dressing is usually given about one and half months after sowing.

Harvesting.—Harvesting commences at the end of about 2 to 2½ months and may last for about 1 to 1½ months.

Yield.—The yield is dependent on a number of factors. Under favourable conditions, the crop may yield upto 5,000 to 6,000 lb. per acre.

Pests and diseases.—There is no serious pest on the crop.

Cost of cultivation per acre.—Pairs at Rs. 4, men at 14 annas and women at 7 annas per day—

	PAIRS.	MEN.	WOMEN.	RS.	A.	P.
Preparatory cultivation.—						
Three ploughings	6	6	..	29	4	0
Forming irrigation channels and digging pits.	½	6½	..	7	11	0
				36	15	0
Manures and manuring.—						
Transporting and applying of farm yard manure.	1	1	4	6	10	0
Cost of 10 cart-loads of farm yard manure at Rs. 4. per cartload.				40	0	0
				46	10	0

Pests ... most serious pest is aphids in the early stages of the ... their multiplication is very rapid, they do considerable ... the foliage, if prompt control measures are not adopted. ... with Nicotine Sulphate mixed with soft soap solution is ... In the latter stages, jassids which harbour on the under ... of the leaves defoliate the crop heavily. These are controlled by dusting with sulphur mixed with six parts of ash. During the flowering time blister beetles damage the flowers. Hand picking of these is the most effective measure of control.

Cost of cultivation per acre :—Pairs at Rs. 4, men at As. 14 and women at As. 7 per day.

	P.	M.	W.		Rs.	A.	P.
Preparatory cultivation :—							
...	6	6	0	..	29	4	0
... channels and ... them ..	1	5	0	..	8	6	0
					37	10	0
Manuring :—							
Transporting and applying 10 cartloads of farm yard manure ..	1	1	4	..	6	10	0
Cost of 10 cartloads of farm yard manure at Rs. 4-0-0 per cartload ..	..			..	40	0	0
					46	10	0
Seeds and sowing :—							
Sowing seed including filling up gaps	0	0	7	..	3	1	0
Cost of 6 lb. of seed at Rs. 3 per lb. ..				..	18	0	0
					21	1	0
After cultivation :—							
Two weedings at 25 women per weeding ..	0	0	50	..	21	14	0
Irrigation :—Eight irrigations on the whole—							
Guiding water at 2 men per irrigation ..	0	16	0	..	14	0	0
Electricity charges at Rs. 2 per irrigation ..				..	16	0	0
					30	0	0

	P.	M.	W.		Rs.	A.	P.
Harvesting :—							
Harvesting charges ..	0	0	60	..	26	4	0
Rent per acre of garden land. On the basis that 2 crops are raised in the same field per year ..				..	50	0	0
Therefore total cost of cultivation per acre ..				..	233	7	0
Outturn per acre :—							
Yield per acre ..	4,000 lb.			..			
Value of produce per acre at Rs. 12 per 100 lb. ..				..	480	0	0
Therefore net profit per acre				..	246	0	0

U. NARASINGA RAO.
Fruit Specialist, Madras.

PRINTED BY THE SUPERINTENDENT GOVERNMENT PRESS, MADRAS.

	PAIRS.	MEN.	WOMEN.	RS.	A.	P.
Seeds and sowing.—						
Sowing				0	14	0
Cost of 2 lb. of seeds at Rs. 3 per lb.				6	0	0
				6	14	0
After-cultivation.—						
Two weedings at 20 women per acre			40	17	8	0
				17	8	0
Irrigations—(Fourteen irrigations)—						
Guiding water at two men per acre		28		24	8	0
Electricity charges at Rs. 2 per irrigation				28	0	0
				52	8	0
Harvesting.—						
Harvesting charges			25	21	14	0
Rent on land (proportionate)				50	0	0
Therefore total cost of cultivation per acre				232	5	0
Yield per acre 5,000 lb.						
Value of produce at one anna per lb.				312	8	0
Therefore, net profit per acre				80	3	0

U. Narasinga Rao,
Fruit Specialist, Madras.

PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS, MADRAS.

MADRAS AGRICULTURAL DEPARTMENT

Economics of Fruit Preservation as a Cottage Industry

Although the fruit and vegetable preservation industry is a large one which has been highly standardized, large quantities of surplus fruits and vegetables are preserved in numerous homes and small concerns all the world over. Large commercial concerns which make use of costly machinery and equipment, which are often fully automatic with labour-saving devices, pack standard and uniform products for use at home and for the export trade. England, Australia, the U.S.A. and South Africa have built up a large export trade in preserved fruit and vegetables. Numerous homes in these countries, however, preserve their own fruits and vegetables during seasons of plenty. Suitable small-scale equipment by way of can sealers, jam boiling pans, pressure cookers, etc., have been specially designed for this purpose. By propaganda and demonstration, home preservation of fruits has become a safe process in the hands of the average housewife in those countries. In India, however, a beginning has yet to be made in this direction. In the meanwhile, small co-operative concerns and the larger orchards can profitably take up the preservation of fruits on a cottage industry scale. The production of highly standardized products in large, well-equipped preservation factories employing automatic machinery and strict technical control should be the ultimate aim.

In the Government Fruit Products Research Laboratory at Kodur, a considerable amount of work has already been done on the preservation of a large number of different kinds of fruits. The methods have been standardized for the preservation of products like canned mangoes, pine-apples, guavas, grape-fruit, etc., fruit juices and squashes like lime, lemon and orange squashes, mango and pineapple squashes, water-melon squash, passion fruit squash, cashew-apple syrup, tomato juice, etc. Different kinds of jams, jellies and marmalades like mango jam, pineapple jam, jack jam, wood-apple jam, banana jam, plum jam, guava jelly, orange marmalade, guava cheese, etc., have all been prepared. Other products like candied kumquat, jack, pineapple, ginger, orange peel and banana fig, banana flour, orange oil, etc., for which methods have been worked out are also of considerable interest. It is thus possible to prepare a large number of useful preserved products from South Indian fruits. In these days of balanced diet, fruits and vegetables with their valuable minerals and vitamins are almost indispensable. They are important protective foods. Unfortunately, they are highly seasonal and much of the crop is wasted or spoilt during periods of glut. This is a serious loss to the country. Modern Science has advanced greatly and it is now possible to preserve fruits and

vegetables in all their freshness and richness so that they can be made available throughout the year. At present preserved fruits and vegetables are considered as luxury foods on account of their high cost. When the industry is well organized, it will be possible to bring them within the reach of the common man. The fruit and vegetable preservation industry is an industry of great national and economic importance and its development on a large factory as well as small home-scale should be the concern of the State.

Capital investment.—Very little equipment is required for the preservation of fruits on a small scale. Many of the items are generally available in the average home. Items like can-sealers, thermometers, hydrometers, glass jars, etc., can be purchased easily. A list of items of equipment which are useful for preparing a variety of fruit products is given in Table I. One will be surprised to learn that with this equipment as many as 100—150 cans of fruit, 100—150 bottles of fruit squash and 50—60 lb. of jam per day can be turned out without any great exertion. The costliest item will be the preparation room and this cannot be avoided. The room should be fly-proof with wire gauze doors and windows. The walls and floor should be smooth and washable. There should be a good drain. A room 20 feet × 20 feet will be sufficient for the preservation room. Raw materials and finished products can be conveniently stored in a separate room.

Cost of production.—A large number of preserved products have been prepared at the Government Fruit Products Research Laboratory using equipment similar to that listed. The cost of production has been worked out. The overhead and supervision charges are, however, tentative. A sum of Rs. 10–12 per day towards these will be ample for a small concern. The cost of sugar at nine annas per pound is rather high. The cost of glass containers, corks and cans is also high on account of the abnormal times. There is ample scope for reducing these considerably in normal times. The tentative cost of production of a few typical products is given in the following paragraphs. Actual working data is also given. The costs are on the high side and will be much less when production is regular and to capacity.

The working capital for raw materials, containers, etc., may be taken on the average at about one rupee per can or bottle.

Establishment.—The persons in charge of the work should have undergone training in fruit canning and preservation at the Government Fruit Products Research Laboratroy. He should have a skilled labourer to assist him in the day-to-day work

G. S. Siddappa,
Biochemist,
Kodur,
Cuddapa district,
Madras.

TABLE I.

Equipment for a small fruit preservation unit.

Serial number.	Particulars.	Number required.	Cost. Rs.	A.	P.
1	Aluminium basins with lids—Capacity 20–100 lb. diameter 10″—20″.	12	250	0	0
2	Saucepans 3–6 lb. capacity	4	10	0	0
3	Mugs	4	4	0	0
4	Strainers	2	6	0	0
5	Trays	2	12	0	0
6	Galvanised steel buckets	6	30	0	0
7	Kerosene stoves with 3—4 burners	2	75	0	0
8	Charcoal ovens with stand	4	16	0	0
9	Sieve for pulping	2	8	0	0
10	Spoons, large	2	3	0	0
11	Spoons, table	6	16	0	0
12	Spoons, tea				
13	Knives, stainless steel	6	18	0	0
14	China plates of different sizes	6	8	0	0
15	Glass tumblers	6	2	0	0
16	Orange squeezer	1	30	0	0
17	Wooden lime squeezer	12	25	0	0
18	Wooden basket press	1	160	0	0
19	Spring balance	1	30	0	0
20	Goldsmith's scales for weighing preservatives, with weights.	1	25	0	0
21	Glass funnel 4″—6″ diameter	2	2	0	0
22	Thermometer 0-240° F.	2	20	0	0
23	Brix hydrometer with jar (0–10, 10–20, 20–30, 30–60 and 60–90).	1 set.	100	0	0
24	Rubber gloves	2 pairs.	5	0	0
25	Beakers 100—250 cc.	6	4	0	0
26	Perforated skimmer	2	2	0	0
27	Can sealer. Dixie automatic	1	150	0	0
28	Burpee canning retort	1	150	0	0
29	Coring knives	6	15	0	0
30	Pineapple eye extractors	3	6	0	0
31	Can opener	1	1	0	0
32	Bottle opener	2	1	0	0
33	Stone jars. 25–50 lb.	12	50	0	0
34	Glass carboys 5–6 gallon capacity	12	150	0	0
35	Cream squeezee	2	12	0	0
36	Pestle and mortar, porcelain	1	4	0	0
37	Bottle cleaning brushes	12	2	0	0
38	Crown corking machine	1	90	0	0
39	Home dryer	1	100	0	0
40	Work tables	3	100	0	0
	Total ..		1,692	0	0

I. Canned Products.

(1) *Canned Mangoes* (i) Neelum (in 40 deg. Brix syrup)—

	Rs.	A.	P.
1. Neelum mangoes, 75 at Rs. 5 per 100	3	12	0
2. Sugar 3 lb. 7 oz. at 9 annas per lb.	1	14	8
3 Charcoal ¾ basket at Re. 1 per basket	0	12	0
4 Labour ¾ man-day at Re. 1 per day	0	12	0
Cost of 11 A 2½ cans prepared	7	2	8
Hence cost of contents per A 2½ can	0	10	5
Add—			
(1) cost of can	0	4	0
(2) overhead charges	0	2	0
Hence cost of A 2½ can of Neelum mangoes	1	0	5
Present sale price	1	8	0

(2) *Bangalora* (in 40 deg. Brix syrup)—

1 Bangalora mangoes, 22 lb. at 0–0–9 per lb.	1	0	6
2 Sugar 2 lb. 10 oz. at 9 annas per lb.	1	7	8
3 Charcoal ¾ basket at Re. 1 per basket	0	12	0
4 Labour ¾ man-day	0	12	0
Cost of 10 A 2½ cans prepared	4	0	2
Hence, cost of contents of one A 2½ can	0	6	5
Add—			
(1) Cost of can	0	4	0
(2) Overhead charges	0	2	0
Hence, cost of one A 2½ can of Bangalora mangoes	0	12	5

(3) *Canned guavas* (in 45 deg. Brix syrup)—

1 Guavas 13 lb. 13 oz., at one anna per lb.	0	14	0
2 Sugar 3 lb. 8 oz. at 9 annas per lb.	1	15	6
3 Charcoal 1 basket at Re. 1 per basket	1	0	0
4 Labour 1 man-day	1	0	0
Cost of 17 A-1 small cans	4	13	6
Hence cost of contents of one A-1 can	0	4	7
Add—			
(1) Cost of can	0	2	0
(2) Overhead charges	0	1	0
Hence cost of one A-1 can of guavas	0	7	7

Note.—A-1 can is only about half the size of A 2½ can.

(4) *Canned Grape fruit* (in 60 deg. Brix syrup) –

1 Grapefruits 4 (4 lb.) at 8 pies per lb.	0	2	8
2 Sugar 1 lb. at 9 annas per lb.	0	9	0
3 Caustic soda for lye peeling ⅔ oz. at 5 annas an ounce	0	3	4

(4) *Canned Grape fruit* (in 60 deg. Brix syrup)—*cont.*

	Rs.	A.	P
4 Charcoal ¼ basket at Re. 1 per basket	0	4	0
5 Labour ¼ man-day	0	4	0
Total cost of contents of 2-A 2½ cans	1	7	0
Hence cost of contents of one A 2½ can	0	11	6
Add—			
(1) Cost of can	0	4	0
(2) Overhead charges	0	2	0
Hence cost of one A 2½ can of grape fruit	1	1	6

Note.—The cost of production of canned chinee orange, lose-jacket orange, pummelo, etc, will be about the same.

II. Juices, Squashes and Cordials.

(1) *Mango squash* (45 deg. Brix)—

1 Country juicy mangoes 200 at Rs. 3 per 100	6	0	0
2 Lime juice 7½ lb. (250 limes) at Re. 1 per 100	2	8	0
3 Sugar 28 lb. 7 oz. at 9 annas per lb.	16	0	0
4 Preservative, potassium meta bisulphite 20 gms. at 0–3–6 per oz.	0	2	6
5 Charcoal 2 baskets at Re. 1 per basket	2	0	0
6 Labour 1 man-day	1	0	0
Total cost of 35 bottles of squash, 24 oz. each	27	10	6
Hence cost of contents per bottle	0	12	8
Add—			
(1) Cost of bottle	0	6	0
(2) Cost of Crown cork	0	0	3
(3) Overhead charges	0	2	0
Hence, cost of one 24 oz. bottle of mango squash	1	4	11

(2) *Chinee orange squash* (60 deg. Brix)—

1 Kodur Chinee oranges, 433 at Rs. 15 per 100	65	0	0
2 Limes 2,000 at Re. 1 per 100	20	0	0
3 Sugar 267 lb. 7 oz. at 9 annas per lb.	150	7	0
4 Preservative, K.M.S., 5 oz., at Re. 0–3–6 per oz.	1	1	6
5 Charcoal, 10 baskets at Re. 1 per basket	10	0	0
6 Labour 5 man-days	5	0	0
Total cost of contents of 230 bottles × 24 oz.	251	8	6
Hence, cost of contents of one bottle	1	1	6
Add—			
(1) Cost of bottle	0	6	0
(2) Cost of cork	0	0	3

(2) *Chinee orange squash* (60 deg. Brix)—cont.

	RS.	A.	P.
(3) Overhead charges	0	2	0
Hence, cost of 1 × 24 oz. bottles of orange squash ..	1	9	9

NOTE.—The cost of fruit is nearly twice the normal price.

(3) *Loose-jacket orange squash* (60 deg. Brix)—

1 Loose-jacket oranges (Coorg or Santra) 110 at Rs. 8 per 100.	8	12	0
2 Limes, 200 at Re. 1 per 100	2	0	0
3 Sugar, 26 lb. 11 oz. at Re. 0–9–0 per lb.	15	0	0
4 Preservative, K.M.S., ½ oz. Re. 0–3–6 per oz.	0	1	9
5 Charcoal, 1½ baskets at Re. 1 per basket	1	8	0
6 Labour, 1 man-day	1	0	0
Total cost of 25 × 24 oz. squash	28	5	9
Hence cost of contents of one bottle	1	2	2
Add—			
(1) Cost of bottle	0	6	0
(2) Cost of cork	0	0	3
(3) Overhead charges	0	2	0
Hence cost of 1 × 24 oz. bottle of squash	1	10	5

(4) *Lime squash* (50 deg. Brix)—

1 Limes, 1,000 at Re. 1 per 100	10	0	0
2 Sugar, 49 lb. 6 oz. at Re. 0–9–0 per lb.	27	12	4
3 Preservative, K.M.S., 1 oz. at Re. 0–3–6 per oz.	0	3	6
4 Charcoal, 2 baskets at Re. 1 per basket	2	0	0
5 Labour 2 man-days	2	0	0
Total cost of 56 × 24 oz. bottles of squash	41	15	10
Hence cost of contents of one bottle	0	12	0
Add—			
(1) Cost of bottle and cork	0	6	3
(2) Over-head charges	0	2	0
Hence cost of 1 × 24 oz. bottle of lime squash	1	4	3

NOTE.—The cost of production is high due to the high cost of sugar.

(5) *Lemon squash* (45 deg. Brix)—

1 Lemons, 38 at Re. 1–0–8 per 100	0	6	4
2 Sugar, 13 lb. 11 oz. at Re. 0–9–0 per lb.	7	11	0
3 Preservative, K.M.S., 9 grams at Re. 0–3–6 per oz.	0	1	2
4 Charcoal, one basket at Re. 1 per basket	1	0	0
5 Labour 1 man-day	1	0	0
Total cost of 17 × 24 oz. bottles of squash	10	2	6

(5) *Lemon squash* (45 deg. Brix.)—cont.

	RS.	A.	P.
Hence cost of contents of one bottle	0	9	7
Add—			
(1) Cost of bottle and cork	0	6	3
(2) Overhead charges	0	2	0
Hence cost of 1 × 24 oz. bottle of lemon squash	1	1	10

(6) *Pineapple squash* (50 deg. Brix)—

1 Pineapples, 12 at Re. 0–8–0 each	6	0	0
2 Limes, 150 at Re. 1 per 100	1	8	0
3 Sugar, 16 lb. 5 oz. at Re. 0–9–0 per lb.	9	3	0
4 Preservative, K.M.S., 10 grms. at Re. 0–3–6 per oz. ..	0	1	3
5 Charcoal, 1 basket at Re. 1 per basket	1	0	0
6 Labour 1 man-day	1	0	0
Total cost of contents of 20 × 24 oz. bottles of squash ..	18	12	3
Hence cost of contents of one bottle	0	15	0
Add—			
(i) Cost of bottle and cork	0	6	3
(ii) Overhead charges	0	2	0
Hence cost of 1 × 24 oz. bottle of pineapple squash ..	1	7	3

(7) *Water-melon squash* (55 deg. Brix)—

1 Water-melons 6	2	8	0
2 Limes, 250 at Re. 1 per 100	2	8	0
3 Sugar, 27 lb. 3 oz. at Re. 0–9–0 per lb.	15	4	8
4 Preservative, sodium benzonate 23·4 gr. at Re. 0–14–6 per oz.	0	12	2
5 Charcoal, 1 basket	1	0	0
6 Labour, 1 man-day	1	0	0
Total cost of contents of 27 × 24 oz. bottles	23	0	10
Hence cost of contents per bottle	0	13	8
Add—			
(i) Cost of bottle and cork	0	6	3
(ii) Overhead charges	0	2	0
Hence cost of 1 × 24 oz. bottle of water-melon squash ..	1	5	11

(8) *Passion fruit squash* (55 deg. Brix)—

1 Passionfruit 14 lb. at Re. 0–4–0 per lb. plus freight.. ..	4	10	0
2 Sugar, 6 lb. 5 oz. at Re. 0–9–0 per lb.	3	9	0
3 Preservative, K.M.S., 3·4 grams at 1·5 pies per gm... ..	0	0	5
4 Charcoal, ¼ basket at Re. 1 per basket	0	4	0
5 Labour, ¼ man-day	0	4	0
Total cost of contents of 6 × 24 oz. bottles	8	11	5

	RS.	A.	P.
Hence cost of contents of one bottle	1	7	3
Add—			
(i) Cost of bottle and cork	0	6	3
(ii) Overhead charges	0	2	0
	1	15	6

NOTE.—The cost of fruit and sugar is very high.

(9) *Cashew apple syrup* (60 deg. Brix)—

1 Cashew apple, 750 at Re. 0–0–3 per 10 fruits	1	2	9
2 Limes, 215 at Re. 1 per 100	2	2	5
3 Sugar, 27 lb. 10 oz. at Re. 0–9–0 per lb.	15	9	0
4 Preservative, K.M.S. 23·5 grams at Re. 0–3–6 per oz. ..	0	3	0
5 Charcoal, 1 basket	1	0	0
6 Labour, 1 man-day	1	0	0
Total cost of contents of 24 × 24 oz. bottles	21	1	2
Hence cost of contents per bottle	0	14	1
Add—			
(i) Cost of bottle and cork	0	6	3
(ii) Overhead charges	0	2	0
Hence cost of 1 × 24 oz. bottle of cashew apple syrup ..	1	6	4

(10) *Fruit cocktail*—

1 Chinee orange squash, 4 × 24 oz. bottles at Rs. 1–9–9 each.	6	7	0
2 Pineapple squash, 4 × 24 oz. bottle at Rs. 1–7–3 each ..	5	13	0
3 Tomato juice, 2 × 24 oz. bottles at Re. 1–1–1 each ..	2	2	2
Total cost of 10 × 24 oz. bottles of fruit cocktail	14	6	2
Hence cost of 1 × 24 oz. bottle	1	7	0

(11) *Tomato juice*—

1 Tomatoes, 24 lb. at Re. 0–8–0 per 3 lb.	4	0	0
2 Common salt, 2½ oz.	0	0	1
3 Charcoal, one basket	1	0	0
4 Labour, ½ man-day	0	8	0
Total cost of contents of 10 × 24 oz. bottle	5	8	1
Hence cost of contents per bottle	0	8	10
Add—			
(i) Cost of bottle and cork	0	6	3
(ii) Overhead charges	0	2	0
Hence cost of one 24 oz. bottle of tomato juice	1	1	1

NOTE.—The cost of tomatoes is very high.

	RS.	A.	P.
(1) Mango jam (Bangalora)—			
1 Mangoes, Bangalora, 74 fruits weighing 73½ lb. at Re. 0–0–9 per lb.	3	7	2
2 Sugar, 35¼ lb. at Re. 0–9–0 lb.	19	13	3
3 Tartaric acid, 6-2/3 oz. at Re. 0–3–6 per oz.	1	7	4
4 Charcoal, 2 baskets at Re. 1 per basket	2	0	0
5 Labour 2 man-days	2	0	0
Cost of 38 × A 2½ cans of jam (85⅝ lb.)	28	11	9
Hence cost of one lb.	0	5	4
Cost of contents of one A 2½ can jam	0	12	1
Add—			
(i) Cost of can	0	4	0
(ii) Overhead charges	0	2	0
Hence cost of 1 A 2½ can mango jam	1	2	1
(2) Mango jam (Neelum)—			
1 Mangoes, Neelum 133 at Rs. 5 per 100	6	10	8
2 Sugar, 16 lb. 8 oz. at Re. 0–9–0 per lb.	9	4	6
3 Tartaric acid, 87·4 grams at Re. 0–3–6 per oz.	0	10	11
4 Charcoal, 1¼ baskets at Re. 1 per basket	1	4	0
5 Labour, 1 man-day	1	0	0
Cost of 41-7/16 lb. of jam (18 cans A 2½ size)	18	14	1
Hence, cost of one lb. jam	0	7	3
Cost of contents of one A 2½ can	1	0	9
Add—			
(i) Cost of can	0	4	0
(ii) Overhead charges	0	2	0
Hence cost of one A 2½ can mango jam	1	6	9
(3) Plum jam—			
1 Plums—Sour, 14 lb. at Re. 0–5–0 per lb.	4	6	0
Freight from Coonoor	0	12	0
2 Sugar, 10 lb. at Re. 0–9–0 per lb.	5	10	0
3 Charcoal, ¾ basket at Re. 1 per basket	0	12	0
4 Labour, ¾ man-day	0	12	0
Total cost of 19½ lb. jam	12	4	0
Hence cost of 1 lb. jam	0	10	1
Cost of jam in an A 2½ can (2⅝ lb.)	1	9	2

	RS.	A.	P.
Add—			
(i) Cost of can	0	4	0
(ii) Overhead charges	0	2	0
Hence cost of an A 2½ can of plum jam	1	15	2

(4) Pineapple jam—

1 Pineapples, 4 at Re. 0–8–0 each	2	0	0
2 Sugar, 3 lb. 11 oz. at Re. 0–9–0 per lb.	2	1	2
3 Limes, 5 at 2 pies each	0	0	10
4 Charcoal, ½ basket at Re. 1 per basket	0	8	0
5 Labour ⅓ man-day at Re. 1 per day	0	5	4
Total cost of 5½ lb. jam	4	15	4
Cost of 1 lb. jam	0	14	5
Cost of 2½ lb. jam (1 A 2½ can)	2	4	1
Add—			
(i) Cost of can	0	4	0
(ii) Overhead charges	0	2	0
Hence cost of an A 2½ can of pineapple jam	2	10	1

NOTE.—The cost is very high on account of the high cost of fruit.

(5) Jack jam—

1 Jack fruit, 2 at Rs. 1–8–0 each	3	0	0
2 Sugar, 9 lb. at Re. 0–9–0 per lb.	5	1	0
3 Tartaric acid, 48 grams at Re. 0–3–6 per oz.	0	6	0
4 Charcoal, 1 basket	1	0	0
5 Labour, 1 man-day	1	0	0
Total cost of 17 lb. jam	10	7	0
Hence cost of 1 lb. jam	0	9	10
Cost of 2½ lb. jam (A 2½ can)	1	8	7
Add—			
(i) Cost of can	0	4	0
(ii) Overhead charges	0	2	0
Hence cost of an A 2½ can of jak jam	1	14	7

(6) Banana jam—

1 Bananas, 61 at Rs. 2–2–0 per 100	1	4	8
2 Sugar, 7¼ lb. Re. 0–9–0 per lb.	4	1	3
3 Tartaric acid, 38 grams at Re. 0–3–6 per oz.	0	4	9

(6) Banana jam—*cont.*

	RS.	A.	P.
4 Charcoal, ½ basket at Re. 1 per basket	0	8	0
5 Labour ½ man-day	0	8	0
Cost of 5 × A 2½ cans (13⅜ lb. jam)	6	10	8
Cost of 1 lb. of jam	0	8	0
Cost of jam in an A 2½ can	1	5	4
Add—			
(i) Cost of can	0	4	0
(ii) Overhead charges	0	2	0
Hence cost of an A 2½ can of banana jam	1	11	4

(7) Custard apple jam—

1 Custard apples, 54 at Rs. 5 per 100	2	11	2
2 Sugar, 3 lb. 3 oz. at Re. 0–9–0 per lb.	1	12	7
3 Tartaric acid, 17 grams at Re. 0–3–6 per oz.	0	2	2
4 Charcoal, ⅛ basket at Re. 1 per basket	0	2	0
5 Labour, ⅛ man-day at Re. 1 per day	0	2	0
Cost of 5 lb. 5 oz. jam	4	13	11
Hence cost of 1 lb. jam	0	14	8
Cost of 2½ lb. jam (1 × 2½ can)	2	4	8
Add—			
(i) Cost of can	0	4	0
(ii) Overhead charges	0	2	0
Hence cost of an A 2½ can of custard apple jam	2	10	8

NOTE.—The cost is high since the yield of jam is low due to losses in handling small experimental lots.

(8) Woodapple jam—

1 Woodapples, 9 at Re. 0–0–6 each	0	4	6
2 Sugar, 1 lb. 8 oz. at Re. 0–9–0 per lb.	0	13	6
3 Tartaric acid 6·4 grams at Re. 0–3–6 per oz.	0	0	10
4 Charcoal, ⅛ basket at Re. 1 per basket	0	2	0
5 Labour, ⅛ man-day at Re. 1 per day	0	2	0
Cost 3$\frac{3}{16}$ lb. jam	1	6	10
Hence cost of 1 lb. jam	0	7	2
Cost of 2½ lb. jam (1 × A 2½ can)	1	1	5
Add—			
(i) Cost of can	0	4	0
(ii) Overhead charges	0	2	0
Hence cost of an A 2½ can of woodapple jam	1	7	5

III. Jams, Jellies and Marmalades—*cont.*

	Rs.	A.	P.
(9) Guava jelly—			
1 Guavas, 36 lb. 14 oz. at Re. 0–1–0 per lb.	2	5	0
2 Sugar, 32 lb. 6 oz. at Re. 0–9–0 per lb.	18	3	5
3 Tartaric acid, 5 oz. at Re. 0–3–6 per oz.	1	1	6
4 Charcoal, 2½ baskets at Re. 1 per basket	2	8	0
5 Labour, 2½ man-days at Re. 1 per day	2	8	0
Cost of 46⅜ lb. of jelly	26	9	11
Hence cost of 1 lb. jelly	0	9	2
Cost of 2½ lb. jelly (1 × A 2½ can)	1	6	11
Add—			
(i) Cost of can	0	4	0
(ii) Overhead charges	0	2	0
Hence cost of an A 2½ can of guava jelly	1	12	11
(10) Orange marmalade—			
1 Marmalade oranges, 115 at Re. 1 per 100	1	2	5
2 Sugar, 13 lb. 7 oz. at Re. 0–9–0 per lb.	7	9	0
3 Charcoal, 1½ baskets at Re. 1 per basket	1	4	0
4 Labour, 1 man-day	1	0	0
Cost of 17¼ lb. (7 A 2½ cans) of marmalade	10	15	5
Hence cost of 1 lb. of marmalade	0	10	2
Cost of 1 × A 2½ can marmalade	1	9	1
Add—			
(i) Cost of can	0	4	0
(ii) Overhead charges	0	2	0
Hence cost of an A 2½ can of orange marmalade	1	15	1

IV. Dried Products.

	Rs.	A.	P.
(1) Banana figs—			
1 Bananas (Pacha Arati, local variety) 200 at Rs. 2 per 100.	4	0	0
2 Sulphur, ½ oz. at Re. 0–2–0 per oz.	0	1	0
3 Charcoal, 2 baskets at Re. 1 per basket	2	0	0
4 Labour, ¼ man-day at Re. 1 per day	0	4	0
Cost of 6½ lb. of figs	6	5	0
Hence cost of 1 lb. of banana figs, loose	0	15	6
(2) Banana flour—			
1 Bananas (Bontha Arati variety) 75 at Rs. 1–8–0 per 100	1	2	0
2 Charcoal, 1 basket at Re. 1 per basket	1	0	0

IV. Dried Products—*cont.*

	Rs.	A.	P.
3 Labour, ¼ man-day at Re. 1 per day	0	4	0
Cost of 2½ lb. flour	2	6	0
Hence cost of 1 lb. of banana flour, loose	0	15	3

V. Candied Products.

	Rs.	A.	P.
(1) Ginger candy—			
1 Ginger, 7 lb. at Re. 0–7–0 per lb.	3	1	0
2 Sugar, 4 lb. at Re. 0–9–0 per lb.	2	4	0
3 Charcoal, ½ basket at Re. 1 per basket	0	8	0
4 Labour, ½ man-day	0	8	0
Cost of 3 lb. candy	6	5	0
Hence cost of 8 lb. ginger candy, loose	2	1	8
(2) Citrus peel candy—			
1 Sugar, 4 lb. at Re. 0–9–0 per lb.	2	4	0
2 Common salt, 1 lb. 13 oz. at Re. 0–0–9 per lb.	0	1	3
3 Charcoal, ⅛ basket at Re. 1 per basket	0	5	4
4 Labour, ¼ man-day	0	4	0
Cost of 3 lb. candy	2	14	7
Hence cost of 1 lb. citrus peel candy, loose	0	15	6
(3) Jack candy—			
1 Jack fruit one at Re. 0–12–0	0	12	0
2 Sugar, 3 lb. at Re. 0–9–0 per lb.	1	11	0
3 Charcoal, ⅛ basket at Re. 1 per basket	0	5	4
4 Labour, ¼ man-day at Re. 1 per day	0	4	0
Cost of 2 lb. candy	3	0	4
Hence cost of 1 lb. of jak candy, loose	1	8	2

Note.—The syrup can be bottled as 'Jak syrup'.

	Rs.	A.	P.
(4) Kumquat candy—			
1 Kumquats, 309 at Re. 0–2–0 per 100	0	6	2
2 Sugar, 9 lb. at Re. 0–9–0 per lb.	5	1	0
3 Charcoal, 1⅛ baskets at Re. 1 per basket	1	8	0
4 Labour, 1 man-day	1	0	0
Cost of 7 lb. candy	7	15	2
Hence cost of 1 lb. kumquat candy, loose	1	2	2

Note.—The candying processes are spread over 8—10 days, but they can be carried out by persons engaged for preparation of other products.

VI. Pickles and Chutneys.

	Rs.	A.	P.
(1) Sweet mango chutney—			
1 Mangoes—Bangalora, 30 fruits (25½ lb.) at Rs. 7–8–0 per 100.	2	4	0
2 Sugar, 14 lb. at Re. 0–9–0 per lb.	7	14	0
3 Common salt, 14½ oz. at Re. 0–0–9 per lb.	0	0	8
4 * Spices, onion, chillies and ginger	1	11	0
5 Vinegar, 3⅝ lb. at Re. 0–12–0 per lb.	2	11	6
6 Charcoal, 1¼ baskets at Re. 1 per basket	1	4	0
7 Labour 1 man-day	1	0	0
Cost of 24⅜ lb. chutney	16	13	2
Hence cost of 1 lb. sweet mango chutney, loose	0	11	1

Note.—The chutney may be packed in 1 lb. glass jars with bakelite caps. It is a very good product.

* Spices, etc., used—

Cloves, 6 tolas	0	4	0
Cinnamon, 6 tolas	0	4	0
Cardamom, 3 tolas	0	3	0
Mace, 3 tolas	0	3	0
Aniseed, 6 tolas	0	4	0
Cumin, 6 tolas	0	2	0
Red chillies, 12 tolas	0	2	0
Onions, 1½ lb.	0	3	0
Ginger, 6 tolas	0	2	0
Total ..	1	11	0

MADRAS: PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS.

100,002—11-2-48

GREEN MANURING OF PADDY

The principal food-crop of the Province is papddy and though is is cultivated in all the districts, the food-suply falls short of our requirements. This is because the average yield is low, being about 1,600 lb. per acre as against 6,000 to 7,000 lb. obtained in Japan, Spain and Italy. It is not difficult to improve the yield of paddy. For instance in some of the Government Agricultural Research Stations where the yield was formerly about 1,600–2,000 lb., the yield is now 3,000 to 4,000 lb. per acre.

2. Food can be produced only from the soil and no amount of talking will help us to produce more food. If food supply is to be improved quickly, the soil has to be tackled by manuring. The question of manure-supply is therefore indissolubly bound up with the well-being and even the bare existence of our people

3. The manures commonly applied to paddy fields are farm-yard manure, green leaves, oilcakes, bone-meal, fertilizers like sulphate or phosphate of ammonia, super phosphate, etc. But the supply of these is at present limited. The only type of manure which can be increased considerably and that too in a short period is green leaves. Experiments in the Agricultural Research Stations and on ryots' fields in all districts have proved the universal efficacy of green leaves in improving the yield of paddy. The increase in the yields varies from 25 to 45 per cent. A maximum response of 50 per cent was noticed with an application of 6,000 to 8,000 lb. of leaves in the case of the Circars districts and West Coast soils and 9 to 17 per cent in the Cauvery delta and Coimbatore district. The average dose is about 4,000 lb. or 3 cart-loads of green leaves per acre. It will be seen that every 40 lb. of green leaves will secure an increase of one Madras measure of paddy. The more leaves we apply as manure, the more food we produce. The solution sounds so simple: yet the food shortage has been chronic.

4. There are two ways of growing green leaves for use as manures for paddy fields :

(*a*) The first is to raise a green manure crop like Pillipesara, Kolinji (Vempali), Daincha, Sunhemp, *Sesbania speciosa*, etc., on the paddy field after the harvest of paddy and plough it in before transplantation.

Pillipesara thrives well on stiff soils; Kolinji on light soils; Sunhemp on medium soils; Daincha and *Sesbania speciosa* on all types of soils. Daincha is also particularly suited to alkaline lands. The seeds of green manure plants are generally sown before harvest of paddy when there is some moisture in the field and the green manure crops thrive on the summer showers where there is no scope for irrigation.

Of the green manure plants, Kolinji has the great advantage of being self-sown after it is once introduced in any area, i.e., when once the crop is established in a paddy field, the Kolinji seeds that scatter from the plant, germinate after the paddy is harvested and therefore there is no need to sow the seeds again in future years. Kolinji can be grown on waste lands and the seeds gathered by village children in their spare moments. It pays to collect the seeds as the price will be raised from Rs. 12 to Rs. 18-8-0 for a bag of 160 lb. from 1st December 1947.

Pillipesara and Sunhemp are also greatly valued as cattle fodder. *Sesbania speciosa* will produce a lakh of lb. of leaves per acre. It decomposes easily in the paddy field, as the stem is pithy and its chief merit lies in the fact that it can thrive under the swampy conditions of the paddy field. When planted along the edges of a paddy field in July at the time of transplantation of paddy each plant produces about quarter of a pound of seeds by December and a few dozen plants will produce the seeds required for sowing an acre by December. The ryot will not therefore be put to the expense of purchasing the seeds every year.

The seeds of green manure plants are not now available in plenty and this will be the case until the wet land ryot learns to produce on his holdings his requirements of seeds even by setting apart a part of his land for this purpose. In order to encourage the production of green manure seeds, the Madras Government have recently offered a subsidy of Rs. 6-8-0 on every 160 lb. of seeds produced.

(*b*) The second method is to raise quick growing shrubs on the bunds of fields. This will suit all areas and in particular all places where there will not be sufficient interval between the harvest of one crop and the transplantation of another to raise a green manure crop on the field. A quick growing shrub like *Glyricidea* (Eruthazhai in Tamil and Rotta Askku in Telugu), Adathoda (Addasaram in Telugu), *Calotropis* (Erukkan in Tamil and Jilledu in Telugu), *Leucaena*, *Jatropha* (Kottamanakku in Tamil and Nepalem in Telugu), Malaipoovarasu (Konda Ganna Ravi in Telugu) may be raised in backyards of houses, village-sites, vacant places, sides of roads, along tank and channel bunds. The leaves of most of these are not browsed by cattle and even goats dislike them. The shrubs stand frequent lopping and no trouble is involved in maintaining them except the initial effort in planting a branch or a stump. Various kind of trees also give abundant supply of leaves, like Pungam (Kamiga), Odiyam (Gumpena), Vadanarayana, etc. But for quick results, the quick growing shrubs may be preferred.

Glyricidea *Leucaena*, etc., are particularly to be recommended as these can be raised from small cuttings and are very quick growing and the roots harbour certain types of bacteria which absorb atmospheric nitrogen for the benefit of the host plant. *Glyricidea* and *Leucaena* are therefore the poor man's fertiliser factories which go on yielding a more or less balanced manure in the shape of green leaves, in spite of repeated loppings. Each *Glyricidea* plant will give 40 lb of leaves in the first year and up to 300 lb. a year after the third year. If *Glyricidea* is raised on the paddy field bunds the ryot will have his manure on the spot ready for use when he gets water for irrigation. If necessary he may even slightly enlarge narrow bunds in places where the stump is planted. Even if 100 plants are planted on the bunds of an acre by enlarging 9-inch bunds to 2 feet, the extra area encroached on the field will be less than 1/300th of an acre. It is not necessary to plant *Glyricidea* on all the bunds, as some will be required for use as paths and for other purposes. *Leucaena* is a thin medium sized tree which has the great merit of possessing a hard wood which can be used for making agricultural implements, for fuel and for house construction. In the irrigated areas *Leucaena* will solve the ryots' fuel

problem and help him to conserve the cattle dung for manuring the fields. These two shrubs can be raised on paddy field bunds without detriment to the crop.

5. It should be realized that unless more leaves are grown more manure cannot be produced and more food will not be forthcoming. The initial effort is not difficult and the gain is enormous.

6. With abundant supply of organic manures to the fields, we can also apply fertilisers without risk to the land. Then only we can hope to get the phenomenal yields obtained in Japan, Spain and Italy. Madras should not lag behind these countries and IT NEED NOT, provided a Province-wide campaign is successfully conducted to plant more shrubs and trees. Trees and shrubs can be planted throughout the year under suitable conditions and it is never too late to start planting them. Remember that if every ryot plants even one useful plant a day and utilizes the leaves for manuring paddy fields, there will be no food scarcity next year or thereafter.

M. S. SIVARAMAN,

4th December 1947. *Director of Agriculture.*

MADRAS AGRICULTURAL DEPARTMENT.

Fruit Juices, Squashes and Cordials

In recent years, great advances have been made in the preservation of fruits and vegetables in different parts of the world. The newer knowledge of nutrition regarding the value of fruits and vegetables as protective foods in the diet of the nation has given a great fillip to the rapid development of the preservation industry. There are several scientific methods of preserving fruits such as canning, dehydration, preparation of jams, jellies, etc. Of these some are technically difficult, while others are quite simple and can be done even at home. For instance, preservation of fruit juices in the form of squashes, syrups, cordials, etc., is a relatively simple process and can be learnt easily. In the Madras Province there are numerous kinds of fruits such as mangoes, oranges, limes, pine-apples, melons, etc., and many of these are well suited for preservation in the form of juices or squashes.

General method. -The method of preparation and preservation of fruit juices is common to many of the fruits. The well ripened fruit is washed well, cut or sliced, and the juice expressed by means of a press. The acidity of the juice is adjusted by adding water in the case of highly acid juices like lime juice, lemon juice, etc., and by adding lime juice or citric acid in the case of sweet juices like mango juice, pineapple juice, melon juice, etc. In the case of fruits with hard pulp, a small quantity of water is added to the slices of fruit and the mixture heated for a few minutes to soften the pulp and the softened pulp is pressed in cloth in a basket press. To the fruit juice calculated amount of sugar is added in the form of crystals or about 70 per cent syrup. The fruit squash thus got is preserved by means of a chemical preservative. The two well known preservatives are potassium metabisulphite and sodium benzoate. They are harmless when used in the proper manner. Potassium metabisulphite is used generally except in the case of coloured juices like pomegranate juice, water melon juice, etc., since it bleaches the colour of the juice. In the case of coloured juices, sodium benzoate is used or they are pasteurised by heating for 30 minutes in water at 175°–180° F. When pasteurised, the product acquires a slightly cooked taste, but this is not a serious objection. Potassium metabisulphite is preferred to sodium benzoate as the latter has a slight burning effect on the throat. Further, the metabisulphite helps to

III. *Orange squash.*—Forty-five degrees Brix and 1·8 per cent acidity—Medium sugar content—

The juice from Chinee or Sathukudi oranges is extracted by cutting the fruit in half and reaming out the juice against a revolving burred cone. In the case of loose jacket oranges like Coorg oranges, the fruit is first peeled and the juice pressed from the segments by placing them in cloth and applying pressure, preferably in a basket press.

Orange juice	1 part by weight.
Water	¾ ,,
Sugar	1¼ ,,
Citric acid	1/20 ,,

K.M.S. at 0·06 per cent.

IV. *Orange squash.*—Sixty degrees Brix—High sugar content—

Orange juice	2 parts by weight.
Lime juice	1 part by weight.
Sugar	1 parts by weight.

K.M.S. at 0·06 per cent.

NOTE.—**Excellent quality orango squash can be prepared from Kichili, Vadlapudi and Batavian oranges also.**

V. *Mango squash.*—Sixty degrees Brix—High sugar content—

Juicy varieties of mangoes like the ' Rasams ' are suitable for preparing mango squash. The juice is squeezed by pressing the pulp in muslin cloth. In the case of harder varieties, the pulp should be softened by heating with ¼ its weight of water for a few minutes and then pressed or rubbed through a fine sieve of hair brush or monel metal to remove coarser particles.

Mango juice	3 parts by weight.
Lime juice	1 part by weight.
Sugar	1 parts by weight.

K.M.S. at 0·06 per cent.

Mango squash.—Forty-five degrees Brix—Medium sugar content—

Mango juice	1 part by weight.
Water	1 ,,
Sugar	1 ,,

K.M.S. at 0·06 per cent.

Citric acid at ¾ lb. per 100 lb. squash.

VI. *Pummelo squash.*—Forty-five degrees Brix—Medium sugar content—

Pummelo juice is obtained by crushing the peeled segments and squeezing in cloth.

Pummelo juice	3 parts by weight.
Lime juice	1 part by weight.
Water	2 parts by weight.
Sugar	4 ,,

K.M.S. at 0·06 per cent.

VII. *Water melon squash.*—Fifty-five degrees Brix—

The melon is cut, the pulp scooped out and the juice pressed in a cloth bag.

Water melon juice	3 parts by weight.
Lime juice	1 part by weight.
Sugar	4 parts by weight.
Sodium benzoate at 0·1 per cent is added (K.M.S. is not added as it bleaches the colour of the squash).	

VIII. *Pineapple squash.*—Sixty degrees Brix—

The fruit is peeled, cored and sliced, and the slices crushed in a grape crusher. The juice is separated by pressing the crushed fruit in a basket press. The juice should not be allowed to stand for a long time after extraction.

Pineapple juice	3 parts by weight.
Lime juice	1 part by weight.
Sugar	5 parts by weight.

K.M.S. at 0·06 per cent.

IX. *Tomato juice.*—Fully ripe red tomatoes are cleaned well in water, trimmed and cut into four pieces. The pieces are heated rapidly to boiling in a shallow pan and kept boiling for 5 minutes. This softens the pulp. The pulp is rubbed by means of a glass jar through muslin cloth spread on a sieve to remove the seeds and skin. To the sieved pulp, one per cent of salt is added. The juice is heated to 185°–190°F, filled hot into clean 12 or 24 oz. bottles and the bottles closed with crown corks. The filled bottles are placed on a pad of cloth in a vessel containing hot water and the water gradually brought to boiling and kept at that temperature for

preserve the Vitamin C in the juice, which is an important constituent of fruit juices. The bottles are cleaned well and sterilized by keeping in boiling water for 30 minutes. To prevent breakage, the bottles are not kept directly on the bottom of the vessel in which the water is boiled but on a false bottom by placing a pad of cloth or inverted lid on the bottom of the vessel. After sterilization, they are taken out, and the water inside poured away before filling them with the preserved fruit juice. The filled bottles are closed with crown corks using a crown corking machine or with ordinary corks which have been dipped in hot paraffin wax to close the pores in them. The fruit juice thus preserved keeps well for nearly one to two years. Before use, it should be diluted five to six times with water to give a delicious drink.

Squashes and cordials.—When the whole fruit pulp is used, the resulting product is called a 'squash', and it is cloudy and contains particles of fruit pulp. Modern tendency is to prepare squashes as they are more nutritious than perfectly clear syrups from which the fruit pulp has been removed by filtration, etc. Cordials are fruit squashes from which the pulp has been removed by settling the fresh juice for some days in large containers and then syphoning the clear supernatant juice. They are generally prepared from citrus fruits like limes, lemons and oranges. Being perfectly clear, cordials are brilliant and attractive. They can, however, be prepared synthetically without using any fruit juice and this often leads to spurious products being placed on the market. Squashes are, therefore, the better type of preserved fruit juices.

Preservation.—The squashes are prepared generally in two strengths, namely, 45 and 55 degrees Brix (or per cent sugar) to suit the tastes of different people. The acidity is kept at 1·5 to 2·0 per cent in the finished product. Potassium metabisulphite is used at the rate of 0·06 per cent which corresponds approximately to one ounce for every 100 lb. of the squash. Sodium benzoate is used at the rate of one-tenth of one per cent by weight of the squash. Before adding to the squash, the chemical is dissolved in a small quantity of clean water or fruit juice and then stirred up with the bulk of the squash. In handling the juice during preparation, it is necessary to avoid contact with iron equipment. Storage and mixing of the fruit juices, which are generally acid, should be carried out in aluminium vessels of good quality or in thickly tinned copper or brass vessels or glass jars. Vessels of stainless steel or monel metal are highly desirable, and these are becoming available recently in India also. The success of preservation depends largely on the care taken in carrying out the processes and in maintaining hygienic conditions in the premises.

Recipes.—At the Fruit Products Research Laboratory, methods have been standardized for the preparation of a large number of fruit juices and squashes from different kinds of fruits. The formulæ for some of the important products which can be easily prepared at home are given here. When these have been mastered, the Biochemist, Fruit Products Research Laboratory, Kodur, will be glad to help you with advice and guidance in preparing the more difficult products. He can also give you details regarding other methods of preservation such as fruit-canning, preparation of jams, dehydration of fruits and vegetables, candying of fruits, etc.

I. *Lime squash.*—Forty-five degrees Brix—Medium sugar content—

	I.	II.
Lime juice	1 part by weight	... 10 lb.
Water	1 ,,	... 10 ,,
Sugar	1½ ,,	... 15 ,,
Preservative.—Potassium metabisulphite (denoted as K.M.S. hereafter), at the rate of 0·06 per cent, i.e., 6 parts per 10,000 parts of squash by weight)		9 gm. or ⅓ oz.

Or

Lime juice	1 part by weight.
Water	¾ ,,
Sugar	1¼ ,,
Preservative.—K.M.S. at the rate of 6 parts per 10,000 parts of squash, i.e., 0·06 per cent.	

Note.—The easier way to remember the quantity of preservative to be added is to memorise that it should be added approximately at the rate of one ounce for every 100 lb. of the finished product. One ounce is equivalent to 2½ tolas or 28½ grams.

II. *Lemon squash.*—Forty-five degrees Brix—Medium sugar content—

The formula is the same as for lime squash. A small quantity of the peel emulsion obtained by crushing and squeezing in cloth, the peel of four fruits for every 100 fruits taken, should be added to the finished squash to improve the lemon flavour. A small wooden lime squeezer easily available in any hardware merchant's shop is very effective in extracting juice from both limes and lemons. Lemon is the European variety of the popular lime or 'nimbu'.

III. *Orange squash.*—Forty-five degrees Brix and 1·8 per cent acidity—Medium sugar content—

The juice from Chinee or Sathukudi oranges is extracted by cutting the fruit in half and reaming out the juice against a revolving burred cone. In the case of loose jacket oranges like Coorg oranges, the fruit is first peeled and the juice pressed from the segments by placing them in cloth and applying pressure, preferably in a basket press.

Orange juice	1 part by weight.
Water	$\frac{3}{4}$,,
Sugar	$1\frac{1}{4}$,,
Citric acid	1/20 ,,

K.M.S. at 0·06 per cent.

IV. *Orange squash.*—Sixty degrees Brix—High sugar content—

Orange juice	2 parts by weight.
Lime juice	1 part by weight.
Sugar	4 parts by weight.

K.M.S. at 0·06 per cent.

Note.—Excellent quality orange squash can be prepared from Kichili, Vadlapudi and Batavian oranges also.

V. *Mango squash.*—Sixty degrees Brix—High sugar content—

Juicy varieties of mangoes like the 'Rasams' are suitable for preparing mango squash. The juice is squeezed by pressing the pulp in muslin cloth. In the case of harder varieties, the pulp should be softened by heating with ½ its weight of water for a few minutes and then pressed or rubbed through a fine sieve of hair brush or monel metal to remove coarser particles.

Mango juice	3 parts by weight.
Lime juice	1 part by weight.
Sugar	1 parts by weight.

K.M.S. at 0·06 per cent.

Mango squash.—Forty-five degrees Brix—Medium sugar content—

Mango juice	1 part by weight.
Water	1 ,,
Sugar	1 ,,

K.M.S. at 0·06 per cent.

Citric acid at ¾ lb. per 100 lb. squash.

VI. *Pummelo squash.*—Forty-five degrees Brix—Medium sugar content—

Pummelo juice is obtained by crushing the peeled segments and squeezing in cloth.

Pummelo juice	3 parts by weight.
Lime juice	1 part by weight.
Water	2 parts by weight.
Sugar	4 ,,

K.M.S. at 0·06 per cent.

VII. *Water melon squash.*—Fifty-five degrees Brix—

The melon is cut, the pulp scooped out and the juice pressed in a cloth bag.

Water melon juice	3 parts by weight.
Lime juice	1 part by weight.
Sugar	4 parts by weight.

Sodium benzoate at 0·1 per cent is added (K.M.S. is not added as it bleaches the colour of the squash).

VIII. *Pineapple squash.*—Sixty degrees Brix—

The fruit is peeled, cored and sliced, and the slices crushed in a grape crusher. The juice is separated by pressing the crushed fruit in a basket press. The juice should not be allowed to stand for a long time after extraction.

Pineapple juice	3 parts by weight.
Lime juice	1 part by weight.
Sugar	5 parts by weight.

K.M.S. at 0·06 per cent.

IX. *Tomato juice.*—Fully ripe red tomatoes are cleaned well in water, trimmed and cut into four pieces. The pieces are heated rapidly to boiling in a shallow pan and kept boiling for 5 minutes. This softens the pulp. The pulp is rubbed by means of a glass jar through muslin cloth spread on a sieve to remove the seeds and skin. To the sieved pulp, one per cent of salt is added. The juice is heated to 185°–190°F, filled hot into clean 12 or 24 oz. bottles and the bottles closed with crown corks. The filled bottles are placed on a pad of cloth in a vessel containing hot water and the water gradually brought to boiling and kept at that temperature for

35 minutes to sterilize the juice. The bottles are then gradually cooled away from draughts to avoid breakage. Tomato juice thus preserved is an excellent beverage.

X. *Lime juice cordial.*—The method of preparation is similar to that of lime squash. The freshly extracted juice is, however, stored in a glass carboy or jar with narrow neck which is filled almost completely leaving only a small space near the neck to allow for any expansion of the juice during storage. Before filling the juice into the container, 0 08 per cent potassium metabisulphite is added to it to act as a preservative. The stored juice becomes clear in about a month. It can be syphoned off from the sediment and converted into lime juice cordial.

KODUR,
CUDDAPAH DISTRICT, MADRAS.

G. S. SIDAPPA,
Biochemist.

GOVT. PRESS, MADRAS.

PADDY MANURING IN MADRAS PRESIDENCY.

Rice being the chief cereal food crop of this Province special attention has been devoted to the study of this crop by the Agricultural Department with a view to increase its yield by resorting to improved methods of cultivation, selection of seeds, timely sowing, irrigation, manuring, etc. Of the various factors involved in augmenting the target of production, the role of manuring is probably the greatest and as such it deserves to be investigated in detail for solving the acute food shortage facing the country at present. It has been fairly well established, that by intensive and adequate manuring of the area under irrigated rice crop, the production can be increased to a great extent. In any scheme of manuring of paddy or any other food crop, the main points to be considered are, the amount of food material required by the crop, the fertility of the soil and the limiting plant food to be supplemented. For economic application of manures, information must be had as to the nature of the elements—whether nitrogen, potassium or phosphorous—needed by the paddy crop, the forms in which these should be applied, their availability and the conditions under which the loss of these ingredients due to leaching, etc., could be prevented. Experiments carried out during the past two decades and more at the several Agricultural Research Stations of the Province, viz., Anakapalle, Samalkot, Maruteru, Aduthurai, Coimbatore and Pattambi and quite recently at Pattukottai in the Cauvery-Mettur Project area, have indicated clearly that paddy needs mainly nitrogen and phosphorous in easily available forms. Potash seldom finds a place in the scheme of manuring as most of the paddy soils in the Province are well up in this plant food element. Nitrogen in the form of ammonium sulphate or oil-cakes and phosphorous as super or ammonium phosphate when applied especially with green manure have invariably proved beneficial to rice crop. The need for these two important manures (nitrogen and phosphorus) as well as bulky organic materials like green leaf or compost or farm-yard manure, has been felt for a large area under paddy in Madras. Nitrogen in organic and inorganic forms with the exception of sodium nitrate has produced very good results.

Among the artificials supplying nitrogen, ammonium sulphate has been found to be the best for rice crop. Unlike sodium nitrate, it is absorbed and exchanged in the soil to a great extent and preserved for the nutrition of the plant during the various stages of its growth. The clayey nature or the paddy soil helps

the fixation of ammonia and indirectly increases the retention of $P_2 O_5$ in soluble state in the soil solution.

Of the various organic manures, green manures have proved very useful and efficient for paddy crop, apart from being very economical. These may easily be grown " in situ " in place where water can be had during the off-season after the harvest of paddy crop or obtained from special trees, shrubs and plants rich in foliage. In regard to other bulky organic manures, such as farm-yard manure and compost, unfortunately, we have very meagre or no experimental data to assess their effect on paddy. Hence no authoritative recommendation could be made about their use and dosage. All the same, their manurial value being similar to that of green leaf, they may be tried on the same dosage basis as for the later wherever they could be had in sufficient quantities.

Again, oil-cakes also, irrespective of their nature—whether groundnut, neem, castor, pungum or tobacco-seed cakes—have all behaved alike in appreciably increasing the yield of the crop when applied on equal nitrogen basis. During recent years, groundnut cake has been in use as supplier of nitrogen for paddy and sugarcane. Its popularity has brought about a great demand for it at present. However, it is not available at present in sufficient amounts to manure all our rice and other commercial crops like sugarcane, plantains, etc. Recourse must necessarily be had therefore to other forms of manures, such as neem, castor, pungum and tobacco-seed cakes, green manures, fish guano, etc., all of which have been tested and found to be equally efficient when applied on the same nitrogen basis. In the absence of sufficient quantity of groundnut cake, the use of other oil-cakes or other manures mentioned above can be advocated with good results, provided they are available at economical rates.

The relative response of rice crop to the various nitrogenous manures, both artificials and organics including green manures, as well as phosphates when these are applied individually and in combination at the several rice research stations is dismissed below :—

MANURIAL EXPERIMENTS ON PADDY.

I. Simple nitrogenous manures.

The experiments while emphasizing the importance of nitrogen for paddy crop have also thrown light on the best method of applying plant food. Ammonium sulphate or ammophos, green manures and oil-cakes in any form, have been found to satisfy the requirements of the crop in all the agricultural stations. The optimum dose of nitrogen lies somewhere between 30 and 40 lb.

for a good return of the crop, depending upon the nature of manure, the locality and the strain. The normal dose may be fixed at 150 lb. for ammonium sulphate to supply 30 lb. Nitrogen while for groundnut, castor and neem cakes the relative doses are 400, 600 and 660 lb. respectively. It is encouraging to note that most efficient response of paddy to ammonium sulphate resulting in increases of 35 to 40 per cent with Pattambi soil of laterite origin, consistently over a period of four years. Again, the application of green manure alone in varying doses, 2,000 to 8,000 lb. per acre has increased the yields of first and second crops up to 42 per cent according to the quantity of manure applied. This practice can therefore be encouraged in this locality even dispensing with the use of cakes and other artificial nitrogen fertilizers. The optimum dose for all the stations, lies around 5,000 lb. of green matter, the percentage increase obtaining therefrom varying from 25 to 45. The addition of oil-cakes of any type at 30 lb. Nitrogen level has increased the yields to the extent of 38, 20 and 30 per cent respectively at Maruteru, Coimbatore and Pattambi. With higher doses up to 60 lb. a progressive response was noticed in all the stations ranging from 30 to 50 per cent depending on the nature of the locality and quantity of the cake applied. In general, any oil cake may be used with maximum benefit for all the areas of the Province to supply at least 30 lb. Nitrogen per acre.

Nitrate of soda has proved ineffective when compared with other nitrogenous manures tried in most of the stations. It is neither economical nor beneficial to use this fertilizer for the crop.

II. Combination of nitrogenous manures.

The combined application of organics and inorganics at Coimbatore, Pattambi, Maruteru and Aduthurai has proved more beneficial than either of these applied alone. The effect, is particularly marked in areas, deficient in nitrogen as at Aduthurai, Maruteru and Pattambi. Experiments carried out with the combination of simple artificials like ammonium sulphate and nitrate of soda to provide 30 lb. nitrogen in varying proportions at Aduthurai, Coimbatore and Pattambi, have resulted in an increased yield of about 20 per cent over control but this in no case is superior to that of ammonium sulphate applied alone. Moreover, the combination of the two fertilizers is not advisable as it would, in the long run, have a deleterious effect on the soil.

Further, the incorporation of ammonium sulphate (75 lb. or 15 lb. nitrogen) over a basal application of green leaf (2,000 lb.) has increased the yield by 40 per cent at Maruteru; while with

the higher doses of artificial supplying 16, 32 and 40 lb. Nitrogen the increase ranged between 40 to 56 per cent during a three-year trial. A striking increase of 60 per cent over control has been recorded at Pattambi consistently for a period of three years when ammonium sulphate (75 lb. to supply 15 lb. nitrogen) is applied with 4,500 lb. green leaf. In conjunction with oil-cakes such as neem, castor, groundnut—still better response has been observed in the same station for ammonium sulphate, when the ratio of organic to inorganic nitrogen is 2 : 1, the total being 45 lb. nitrogen. Increases ranging between 55 to 63 per cent have been noted in the case of second crop only for the various combinations of ammonium sulphate with these cakes, supplied an equal nitrogen basis. From a recent experiment at Aduthurai it is seen that there is an increase of 50 per cent over ' No manure ' for the treatment " 100 lb. ammonium sulphate (20 lb. nitrogen) plus green leaf 4,000 " per acre. The study of these experiments reveal that a judicious combination of organic and inorganic manures, viz., green leaf at 5,000 lb. plus ammonium sulphate 75 lb. (15 lb. nitrogen) or " oil-cake in any form to supply 30 lb. nitrogen plus ammonium sulphate 75 lb. (15 lb. nitrogen) is best suited for paddy crop. On no account either on grounds of efficiency or economy, sodium nitrate either alone or in combination should be resorted to for the soils of the Province to meet their nitrogen requirements.

III. Phosphatic manures in presence and absence of nitrogeneous manures.

Next in importance to nitrogen is phosphoric acid in which almost all our paddy soils are very poor. The phosphate, to respond readily, must be in easily available forms like super or ammonium phosphate. A normal dosage of about 30 lb. phosphoric acid may be applied according to the nature of the soil and the number of crops grown in a year.

The importance of phosphoric acid lies in its effect of producing good quality grain. The phosphates like super bonemeal, bone jelly, when applied at 30 lb. phosphoric acid level in a few stations, viz., Coimbatore and Aduthurai have not, however, shown any appreciable increase in yields, the maximum obtained being about 17 per cent over control at Coimbatore and 5 to 11 per cent at Aduthurai. The behaviour of these fertilizers when tried alone is rather erratic but in conjunction with organic or inorganic nitrogenous manures such as green leaf and ammonium sulphate, they all respond well. Mixtures of nitrogenous fertilizers like ammonium sulphate with super supplying varying amounts of nitrogen and phosphoric acid when tested at Samalkota and Aduthurai have given increased yields up to 26 and 36 per cent

respectively in the two centres, the best response being for a combination of 30 lb. nitrogen and 30 lb. phosphoric acid. The use of bonemeal and ammonium sulphate under similar circumstances have proved ineffective in increasing the yields; the rise in the several cases ranges from 7 to 14 per cent only. When phosphate at constant level (30 lb. phosphoric acid) as super is applied with increased amounts of green manure, the yields in most of the stations have gone up by 20 to 38 per cent over control. Between bonemeal and super, the latter is superior and it is advantageous to apply super along with green manure or any other organic nitrogenous manure. At Pattambi fish guano, which is rich in both nitrogen and phosphoric acid has enhanced the yields of the first and second crops by 51 and 25 per cent respectively when applied at 400 lb. level to supply 30 lb. nitrogen and 30 lb. phosphoric acid in combination with 2,000 lb. green leaf. In the case of niciphos which is also a concentrated nitrogenous and phosphatic fertilizer, a rise of 30 per cent over control has been recorded at Samalkot when applied to provide 30 lb. of nitrogen and phosphoric acid. The efficiency of this fertilizer is greatly enhanced in presence of green leaf (2,000 lb.) when applied to supply 16, 32 and 48 lb. of nitrogen and phosphoric acid each; the maximum increase obtained being 58 per cent over ' No manure ' for the 32 lb. combination at Maruteru during a two-year trial.

Other experiments with different types of phosphates, viz., super, niciphos, ammophos, bonemeal, etc., in combination with green leaf and ammonium sulphate have contributed to striking increases in yields. These experiments in general, indicate the better response of phosphoric acid when applied along with suitable nitrogenous manures like green leaf, cakes, or preferably a combination of both.

It is true that the addition of nitrogenous and phosphatic manures in combination, e.g., " green manure plus super," or " cake plus super " in varying doses has not increased the yields appreciably when compared to the performance of nitrogenous manures by themselves. On this score the importance of phosphoric acid for paddy crop cannot be under-estimated. To maintain the potential reserve of this important plant food in our soils and for the production of normal crop of good quality in the years to come, it is imperative that phosphates (either as fish guano or as super or ammophos) should be added at least periodically in adequate amounts, preferably with sufficient quantity of bulky organic materials like green manure and oil-cakes.

Summing up, the following general schedule of manuring may be recommended for all the paddy areas of the Province and suitable manures may be selected depending upon their availability.

Green manures 5,000 lb. per acre to provide 30 lb. nitrogen either alone or preferably in combination with the following :—

	LB.	
1. Oil cakes—		
Neem	330	Supplying 15 lb. nitrogen.
Castor	300	
Pungum	360	
Tobacco seed	330	
Groundnut	200	
2. Ammonium sulphate	75	
3. Ammonium phosphate	100	
4. Fish guano	200	

Items 3 and 4 supply phosphoric acid also, 20 and 15 lb. respectively.

In addition to these manures easily available phosphates such as super (1½ cwt.) or fish guano (400 lb.), ammophos to provide 30 lb. phosphoric acid may be added as frequently as possible, at least once in two or three years, subject to their availability. This would assure the maintenance of soil fertility and production of good quality grain.

Note.—Depending on the availability, farm-yard manure and/or compost may also be applied in the place of green manure on the same dosage, viz., 5,000 lb. per acre.

MADRAS : PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS—1918.

PREPARATION OF COMPOST MANURE FROM TOWN WASTES.

Introduction.

Soils in India are known to be in general deficient in humus and as the high temperature prevailing causes rapid destruction of the organic matter present in the soil, it becomes necessary to provide for the replenishing of the stock of humus in the soil by repeated application of bulky organic manures to cultivated fields. Organic matter exercises a beneficial influence on all kinds of soils ranging from heavy clays to sandy loams and including saline and alkaline soils.

The chief source of supply of organic matter to the soil, viz., farm-yard manure being, however, inadequate to meet the requirement of the existing area under crop, the utilization of urban wastes including night-soil, rich in manurial ingredients becomes a matter of great importance.

Manurial value of town wastes.

The town wastes may be classified under the following heads : (1) dry refuse (street sweepings and dust-bin refuse), (2) night-soil, (3) urine and (4) slaughter-house wastes. It is estimated that the output of dry refuse would roughly amount to $\frac{2}{3}$ to $\frac{3}{4}$ lb. per head of population per day and that of night-soil to $\frac{1}{3}$ to $\frac{1}{2}$ lb. In most areas, the urine is only partially collected, most of it going into sullage along with ablution water. Estimating the mortality of cattle population at 10 per cent caused by natural death and by slaughtering for food, the wastes from 2,100,000 heads of cattle will be available for manurial purposes.

Out of the total population of 50 millions in the Province of Madras, 8 millions may be taken as residing in urban areas where household privies or public latrines exist and sanitary staff is available for collection of the refuse and nightsoil.

The percentage composition of each class of the above wastes and their total manurial value corresponding to an urban population of 8 millions in the Province of Madras are given below :—

Approximate chemical composition of town wastes.

Material.	Percentage on fresh material.			Percentage on oven dry material.				
	Moisture.	Dry matter	Organic matter.	Carbon.	Nitrogen.	Phosphoric acid P_2O_5.	Potash K_2O	Lime CaO.
1 Town refuse ..	10–15	85–90	25–30	14–15	0·7–0·8	0·4–0·5	1·2–1·4	7·0–8·0
2 Night-soil ..	75–80	20–25	19–24	45–50	5·5–6·0	4·0–4·5	2·0–2·5	4·5–5·0
3 Urine ..	93–95	5–7	4–5	12–15	18–20	2·8–3·0	3·4–3·6	5·0–5·5
4 Mixed slaughter-house wastes (solid).	75–80	20–25	18–22	15–16	8–10	3·0–3·5	2·0–2·5	3·0–3·5

Manurial value of urban wastes in the Province of Madras per year.

Urban population 8 millions.

Material.	Dry matter.	Nitrogen.	Phosphoric acid. (P_2O_5)	Potash K_2O.	Lime CaO.
	TONS.	TONS.	TONS.	TONS.	TONS
Town refuse	800,000	6,400	2,400	16,000	40,000
Night-soil	120,000	7,000	3,500	1,750	3,000
Urine	150,000	23,000	3,000	4,700	7,000
Slaughter-house wastes ..	16,000	1,600	700	150	500
Total ..	1,086,000	38,000	9,600	22,600	50,500

PRESENT METHOD OF DISPOSAL.

The above materials of great manurial value are not at present being put to the best possible use. In most of the municipalities of this Province, a major portion of the dry refuse is dumped into low-lying areas round about the town, only a fraction being used to cover the night-soil in the trenching system of night-soil disposal.

The ' pitting ' or trenching system of night-soil which consists in depositing it in trenches to a depth of 2 to 3 feet and covering up with a layer of rubbish on top is unsatisfactory as it gives rise to considerable foul smell and fly-breeding. Further an inordinately long time is required for the night-soil to get into a condition suitable for handling and application to the fields.

No proper method is adopted for converting Slaughter-House wastes consisting of blood, waste meat, liver, intestines, offal, etc., into useful manure.

THE COMPOST SYSTEM.

It has been found that the system of compost making is a very satisfactory method of disposal of town wastes from the point of view of sanitation and of manurial value and of the several systems recommended by various workers and the technique developed at the Indian Institute of Science, Bangalore, and described below appears to be worthy of adoption, being the cheapest, simplest and the most sanitary.

The site selected for the compost depot may be situated about half a mile away from the outskirts of the town and on the windward side. The composting is preferably carried out in trenches with dimensions varying from 15 feet long, 5 feet broad and 3 feet deep for an area of 5,000 population to 40 feet long, 9 feet broad and 3 feet deep for towns of more than 50,000 people. The number of trenches should be as many as will be necessary to receive all the rubbish and night-soil collected from the particular town for a period of eight months. The trenches may be arranged in rows such that the longer sides are parallel and the shorter ends are in the same line, leaving 5 to 6 feet vacant space between successive trenches.

For calculating the number of trenches required for a particular area and the number of carts of rubbish and night-soil for each layer in the trench, the following data will prove useful.

The total compost manure that may be expected to be obtained from any town, may roughly be put at one-tenth of the population in tons.

One cubic foot of town refuse may be taken to weigh roughly 20 lb.; 1 cubic foot of night-soil 60 lb.; 1 gallon of night-soil 10 lb. and 1 cubic foot of compost manure containing 30 to 40 per cent moisture about 40 lb.

The composting of town refuse and night-soil is preferably carried out in trenches of size 20 feet to 30 feet length, 6 to 8 feet breadth and $2\frac{1}{2}$ to $3\frac{1}{2}$ feet depth, depending on the population of the town.

COMPOSTING PROCEDURE.

A layer of dry refuse about 9 inches thick is spread at the bottom of the trench and over this is added night-soil to a thickness of 3 inches corresponding to a quantity equal in weight to that of the dry refuse. The actual number of cart-loads of dry refuse and night-soil required per layer may be calculated from the data given above. Succeeding layers of dry refuse and night-soil are similarly added till the heap rises to a foot above ground level. The top layer at the end of each day should be dry refuse about 9 inches thick and this may be covered with a $\frac{1}{2}$ to 1 inch layer of earth. If the weight of dry refuse collected is greater than that of nightsoil collected, the proportion of dry refuse used for each layer of compost may be increased up to a limit of 2 parts by weight of the former to one part by weight of the latter.

Within three or four days after filling up the trench, high temperature (over 60°C) is developed in the mass and as it persists for two to three weeks, pathogenic organisms, and weed seeds are destroyed to a great extent.

The top surface of the heap may be made dome-shaped and covered with a one–two inch layer of earth after five or six days from the date of finishing the heap. After a period of 8 months the material within the heap is found to have thoroughly decomposed into an innocuous and odourless material of high manurial value, equal if not superior to ordinary farm-yard manure.

SALIENT POINTS TO BE REMEMBERED IN THE ABOVE PROCESS OF COMPOST-MAKING.

(1) *Preliminary treatment.*—Non-agricultural materials such as porcelain and iron pieces, brick bats, glass, etc., that are found in the town refuse may be picked out by hand while spreading the latter in the trenches, or at the time of disposal of the manure, a $\frac{1}{2}$ inch expanded metal sieve may be kept on the top of the cart and the baskets of manure thrown on the sieve. The undesirable materials collecting on the sieve may be shaken off from time to time.

(2) *Covering trenches with earth.*—The thin cover of earth serves to prevent fly-breeding and the escape of foul smell and helps to conserve moisture and nitrogen within the heap. When,

however, earth is not available, it is advisable to use the previous season's old manure to a thickness of about 6 inches for covering the top of the heap.

(3) *Accessories and tools.*—Besides the ordinary mammuti and bamboo baskets, a few rakes with two or three prongs and 5–6 feet wooden handle for spreading the dry refuse in the trenches and a few night-soil spreaders are the only tools required. The night-soil spreader consists of a square piece of iron fixed perpendicular to the length of a 5–6 feet piece of bamboo handle.

(4) *Moisture.*—Normally, when the proportion of night-soil to dry refuse is 1 :1 by weight, there is about 40 to 50 per cent moisture in the heap which is enough for satisfactory decomposition. When the top 1–½ foot layer happens to become dry in the summer, it may be wetted with sullage water and covered with a thin layer of earth or fresh rubbish. If the top surface sinks below ground level, a fresh layer of night-soil may be added on the top and this may be covered with a layer of rubbish.

During the rainy season, to prevent rain water getting into the heap, it should be raised to about 1 foot above ground level and the top made dome-shaped and covered with earth. Precautions should also be taken to prevent rain water flowing into the trenches from surrounding areas.

(5) *Areas of high water-table.*—In areas of high water table, where trenches could not be dug to a depth of 3 feet without reaching the water level, it will be necessary to carry out the composting in above-ground heaps.

A circular heap of rubbish 2 feet high and of about 10 feet diameter is built up. The edges are raised 2 feet higher by the addition of more refuse and into the basin thus formed, night-soil equal to about half the weight of the refuse is added and covered over with the refuse drawn from the edges. The heap is then covered over with a 1–2 inch layer of earth and left undisturbed for a month. After a month, a turning is given to the heap which is made again into basin form to receive a second dose of night-soil equal in weight to the first and is treated as before. After a few months the manure is ready for sale.

Night-soil whether converted into poudrette by the trenching system or compost manure as described above is of high manurial value and its effect on crop yields compares favourably with that of farm-yard manure or other composts.

An approximate composition of the poudrette and night-soil compost and data on their effect on crop yields are furnished below :—

Nature of the material.	Percentage on dry matter.		
	N.	P_2O_5.	K_2O.
1 Poudrette made by adding rubbish	2·31	2·07	1·28
2 Poudrette made by adding soil	1·03	0·81	0·47
3 Compost from night-soil and rubbish	1·13	1·08	1·06

Effect on crop yields.

Place of experiment.	Crop.	Particulars of experiment.			Yield per acre in pounds.
1 Central Farm, Coimbatore.	Fodder-Cholam ..	(a) Cattle manure to supply 40 lb. of N per acre.			40,416
		(b) Poudrette manure to supply 40 lb. of N per acre.			40,472
2 Do. ..	Late ragi ..	(a) Compost manure			2,658
		(b) Farm-yard manure			2,600
	Early ragi ..	(a) Compost manure			3,682
		(b) Farm-yard manure			3,385
	Cho'am (spoiled by insect attack).	(a) Compost manure			465
		(b) Farm-yard manure			385
3 Agricultural Research Station, Anakapalle.	Punasa ragi ..	(a) Poudrette			1,075
		(b) Farm-yard manure			1,187
4 Indore	Lucerne	(a) Farm compost—			
		(1) Ten cart-loads			17,620
		(2) Twenty cart-loads ..			25,680
		(3) Thirty cart-loads			25,200
		(b) Compost from habitation wastes—			
		(1) Ten cart-loads			28,080
		(2) Twenty cart-loads ..			32,400
		(3) Thirty cart-loads			38,080
			1 unit.	2 units.	3 units.
5 Do.	Wheat	(a) Farm compost.	1,325	1,483	1,829
		(b) Habitation waste.	1,310	1,757	1,886
6 Manjri Farm	Sugarcane ..	(a) Farm-yard manure 43 tons per acre.			7,885 lb. gul. ye
		(b) Poudrette 42 tons per acre..			13,270 ,,
			3 tons.		5 tons.
7 South Gujarat ..	Cotton	(a) Poudrette ..	532 lb.		659 lb.
		(b) No manure			457 ,,
8 Dharwar	Jowar	(a) Poudrette 5 tons per acre ..			1,087 ,,
		(b) No manure			688 ,,

In view of the poor and declining fertility of our soils and of the urgent need for increased food production to meet the needs of the increasing population, it is imperative that all the available habitation wastes which are potentially of high manurial value should be properly composted and utilized for agricultural purposes only.

COIMBATORE
13*th November* 1947.

P. D. KARUNAKAR,
Government Agricultural Chemist.

NOTE.—Condensed from Bulletin No. 60 of the Imperial Council of Agricultural Research with the kind permission of the author.

MADRAS : PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS—1948.

Results of Manurial Trials in Madras

It is well known that the three most importment nutritients required by crops are nitrogen, phosphoric acid and potash. If any of these plant foods is not present in the soil in adequate amounts crop yields become reduced. The purpose of adding manures in cultivation is to ensure that these plant foods are available to crops for optimum production. The approximate amounts of the plant nutrients removed by the principal crops of our State are presented in the following table :—

	Manurial ingredients removed in lb./Acre.		
	Nitrogen.	*Phosphoric acid.*	*Potash.*
Paddy	48	23	41
Sugarcane	56	68	190
Cotton	97	29	83
Tobacco	67	9	85
Plantain	200	80	800
Cholam	72	25	45
Ragi	49	30	202
Wheat	37	13	20
Cambu	28	10	11
Varagu	23	10	17
Maize	25	10	25
Tenai	19	8	22
Potatoes	47	22	77

From the table it is clear that all our crops remove considerable amounts of plant nutrients from the soil If this is not made good by the application of manure the fertility of the soil would decrease, the yields would go down and cultivation would become uneconomic.

The soils of Madras with the exception of those in the coastal strips and the hills contain a sufficiency of potash. So, except in the east and west coasts and in the hills and for certain crops such as plantain and tobacco, manuring with potassi fertilizers is generally not necessary. But all the soils of the State are deficient in nitrogen and phosphoric acid. Another essential ingredient which is in short supply in our soils is organic matter. Since our State is in the tropics the loss of organic matter from the soil is enormous and unless the loss is made good, crop production would suffer. Organic matter to the soil may be supplied in the form of farmyard manure, green manures, composts, etc. The available supply of farmyard manure is only about one-twenty-fifth of the demand. Farm waste compost and night soil compost have been shown to be as good as cattle manure. But these also are not made in sufficient quantities although many municipalities have started making compost from town refuse. Green manures are very useful and may be applied either by bringing suitable green leaves from outside and incorporating them into the soil or by growing leguminous green manure crops on the soil and by ploughing them in. Of these two methods, the growing of the legume on the soil and ploughing it in the soil is better because both organic matter and nitrogen are added to the soil. The legumes fix nitrogen from the inexhaustible store in the air and make it available to crops. Recent research has shown that when phosphatic manures are applied

to the legumes, the organic matter and nitrogen added to the soil are also considerable and the phosphate is more readily available to the succeeding grain or cash crop than by direct application. So this is a method of adding nitrogen to the soil. Other manures which are generally used in our country to augment nitrogen supplies for the crops are oil-cakes such as groundnut cake, casto cake, etc., ammonium sulphate, ammonium and sodium nitrate, calcium cyanamide and others. However, ammonium sulphate and oil cakes are more generally used in our State than the other manures. The phosphatic manures that are in common use in Madras are superphosphate, rock phosphate, bone meal of various grades, etc. Other phosphatic manures such as ammophos, diammophos, Niciphos, etc. are only rarely employed. Phosphoric acid content cannot be increased in the soil except by the application of phosphatic manure. Nitrogen and organic matter, can, however, be increased without much cost by growing leguminous green manure crops after inoculation and with phosphate application and ploughing them into the soil.

At Coimbatore and at the various agricultural research stations scattered over the State the different green manure crops, green leaves, farmyard manure, and the nitrogenous, phosphatic, and potassic manures singly and in combination have been tried for all the crops and their dosages worked out. From the results obtained it may be stated in general that for most of the cereals, 30 lb. of nitrogen and 30 lb. of phosphoric acid over a basal dressing of 5,000 lb. of green matter per acre are sufficient for maintaining soil fertility and crop production. Experiments with different crops indicate that farm waste compost and night soil compost are as good as farmyard manure. In a few instances they have, however, proved inferior to farmyard manure.

The following table gives a summary of the results and recommendations in respect of manure for the various crops in the different localities of the State. These values have been obtained as a result of the experiments conducted over a series of years.

Crop.	*Locality.*	*Manures recommended and dosage per acre.*
		NITROGENOUS MANURES.
Paddy	Maruteru	Green manure 4,000 to 5,000 lb. or groundnut cake 675 lb. or ammonium sulphate 100 lb.
Do.	Samalkot	Green manure 6,000 lb. or ammonium sulphate 150 lb.
Do.	Anakapalli	Green manure 6,000 to 8,000 lb.
Do.	Aduthurai	Ammonium sulphate 150 lb. or green manure 4,000 lb.
Do.	Coimbatore	Ammonium sulphate 150 lb. or groundnut cake 425 lb. or green manure 6,000 lb.
Do.	Pattambi	Ammonium sulphate 150 lb. or groundnut cake 425 lb. or green manure 5,000 lb.
		COMBINATION OF ORGANIC AND INORGANIC NITROGEN.
Paddy	Maruteru	Green leaf 2,000 lb. plus ammonium sulphate 100 lb.
Do.	Pattambi	1. Castor cake 700 lb. plus ammonium sulphate 75 lb. 2. Green leaf 4,000 lb. plus ammonium sulphate 75 lb.
Do.	Do.	3. Groundnut cake 425 lb. plus ammonium sulphate 75 lb.
		NITROGEN AND PHOSPHATE COMBINATIONS.
Paddy	Samalkot	1. Green manure 5,000 lb. plus superphosphate 170 lb. 2. Ammonium sulphate 150 lb. plus superphosphate 170 lb. 3. Green manure 2,250 lb. plus superphosphate 170 lb. plus ammonium sulphate 75 lb.
Do.	Maruteru	1. Green leaf 2,000 lb. plus ammonium sulphate 160 lb. plus superphosphate 180 lb. 2. Groundnut cake 650 lb. plus flour phosphate 48 lb. P_2O_5.
Do.	Aduthurai	1. Ammonium sulphate 100 lb. plus superphosphate 75 lb. 2. Green leaf 2,000 lb. plus superphosphate 112 lb.
Do.	Coimbatore	Green leaf 5,000 lb. plus superphosphate 112 lb.
Do.	Pattambi	Do. Do.

Crop	*Locality*	*Manures recommended and dosage per acre.*
Sugarcane	Anakapalli	Cattle manure 5 tons plus green leaf 2,000 lb. plus superphosphate 112 lb. plus ammonium sulphate 160 lb.
Do.	Samalkot	1. Ammonium sulphate 500 lb. plus bone meal 224 lb. plus superphosphate 224 lb. 2. Groundnut cake 1,200 lb. plus bone meal 224 lb. plus superphosphate 224 lb.
Do.	Palur	1. Groundnut cake 1,000 lb. plus ammonium sulphate 100 lb. 2. Groundnut cake 800 lb. plus ammonium sulphate 200 lb.
Plantain	Samalkot	Ammonium sulphate 2½ oz. plus potassium sulphate 2½ oz. plus superphosphate 3½ oz. per tree.
Do.	Palur	Potassium sulphate 168 lb. plus groundnut cake 560 lb. plus superphosphate 224 lb. per acre.

GARDEN LAND CROPS.

Cotton	Coimbatore	1. Cattle manure 15 cartloads 2 Green manure ploughed in situ (red soil.) 3. Ammonium sulphate 336 lb. 4. Potassium sulphate 100 lb plus superphosphate 336 lb.
Do.	Guntur, Nandyal and Hagari	Ammonium sulphate 224 lb. plus superphosphate 112 lb. plus cattle manure 5 cartloads. Compost and cattle manure at 50 lb. nitrogen (3 tons).
Do.	Koilpatti	Groundnut cake 250 lb. plus ammonium sulphate 112 lb. plus superphosphate 112 lb. plus cattle manure 3 tons.
Cholam	Coimbatore	Cattle manure 5 tons.
Do.	Guntur, Hagari, Nandayal and Koilpatti.	Ammonium sulphate 224 lb. plus superphosphate 112 lb plus cattle manure 3 tons.
Do.	Koilpatti	Groundnut cake 500 lb. plus superphosphate 112 lb. plus cattle manure 2 tons plus cotton compost 1 ton.
Ragi	Coimbatore	Cattle manure 5 tons per acre.
Groundnut	Palur	Cattle manure 5 cartloads plus superphosphate 112 lb.
Do.	Nandyal	Cattle manure 3 tons.
Tenai	Hagari	Cattle manure 6,000 lb. (50 lb. nitorgen).
Cumbu	Koilpatti	Ammonium sulphate 224 lb. plus superphosphate 112 lb. plus cattle manure 3 tons plus cotton compost 1 ton.
Maize and Variga	Guntur	1. Kossier phosphate 224 lb. plus bone meal 224 lb. plus cattle manure 3 tons. 2. Cowpea ploughed in situ plus superphosphate 56 lb.
Tobacco and Chillies	Guntur	Ammonium sulphate 224 lb. plus potassium sulphate 100 lb. plus cattle manure 2 tons.
Pepper	Taliparamba	Leaf mould 20 lb. plus fish guano ¼ lb. plus sodium nitrate or ammonium sulphate ½ lb. plus superphosphate ¼ lb. plus lime ½ lb. per vine.
Coconut	Kasargod and Pilicode	Ammonium sulphate 3 lb. plus ashes 20 lb. plus cattle manure 100 lb. per tree.
Potato	Nanjanad	Groundnut cake 500 lb. plus ammonium sulphate 200 lb. plus steamed bone meal 350 lb. plus potassium sulphate 224 lb. plus concentrated superphosphate 336 lb.

The correct dosage of manures has been worked out for each crop in the different agricultural research stations. These stations are typical of the tracts in which they are situated and it is to the advantage of the farmers to use the manurial dosage advocated by the agricultural research stations near about them.

The increase in yield over the control by the use of the dosages of the manures recommended at the various agricultural research stations are given below (Ref: A Review of the Manurial Experiments on the Agricultural Crops of the Madras Presidency for the second period 1930–40) M.A.J. Vols. XXI No 11 November 1943 XXXII Nos. 1, 2, 3 and 4, January, February, and March-April 1944.

Crop.	*Locality.*	*Manures recommended and the dosage per acre.*	*Percentage increase in yield over the control as a result of application.*	*Normal yield (control), lb.*
		SIMPLE NITROGENOUS MANURES		
Paddy ..	Maruteru ..	1. Green manure 4,000 to 5,000 lb.	14 (First crop) ..	1,500
			34 (Second crop).	1,500
		2. Groundnut cake 675 lb.	51 (Second crop).	1,500
		3. Ammonium sulphate 100 lb.	25 (First crop) ..	2,000
			28 (Second crop).	1,500
	Samalkota ..	1. Green manure 6,000 lb.	13 (First crop) ..	3,500
		2. Ammonium sulphate 150 lb.	12 (First crop).	3,000
	Anakapalli ..	Green manure 6,000 to 8,000 lb.	44 to 51 ..	1,800
	Aduthurai ..	Ammonium sulphate 150 lb.	25 (First crop) ..	2,500
		Do.	34 (Second crop).	1,700
		Green manure 4,000 lb.	9 (First crop) ..	2,500
	Coimbatore ..	Ammonium sulphate 150 lb.	27	3,300
		Groundnut cake 750 lb.	20	2,400
		Green manure 6,000 lb.	17	2,400
	Pattambi ..	Ammonium sulphate 150 lb.	42 (First crop) ..	1,300
		Do.	34 (Second crop .	1,700
		Groundnut cake 425 lb.	30	..
		Green manure 5,000 lb.	42	1,300
		COMBINATION OF ORGANIC AND INORGANIC NITROGENOUS MANURE.		
Paddy ..	Maruteru ..	Green leaf 2,000 lb. plus ammonium sulphate 100 lb.	40	1,500
	Pattambi ..	Castor cake 750 lb. plus ammonium sulphate 75 lb.	59	1,460
		Green leaf 4,500 lb. plus ammonium sulphate 75 lb.	60	1,460
		Groundnut cake 425 lb. plus ammonium sulphate 75 lb.	63	1,460
		NITROGEN AND PHOSPHATE COMBINATIONS.		
Paddy ..	Samalkota ..	Green leaf 4,500 lb. plus superphosphate 167 lb. ..	31	1,900
		Ammonium sulphate 130 lb. plus superphosphate 170 lb.	26	1,900
		Green mannre 2,250 lb. plus ammonium sulphate 75 lb. plus superphosphate 170 lb.	33	1,900
	Maruteru ..	Green leaf 2,000 lb. plus ammonium sulphate 160 lb. plus superphosphate 180 lb.	56	1,500
		Groundnut cake 650 lb. plus flour phosphate to supply 48 lb. of P_2O_5.	48	1,500
Paddy ..	Aduthurai ..	Ammonium sulphate 100 lb. plus concentrated superphosphate 75 lb.	38	2,500
		Green leaf 2,000 lb. plus superphosphate 112 lb. ..	25	2,100
	Coimbatore ..	Green leaf 4,000 lb. plus superphosphate 112 lb. ..	19	3,000
	Pattambi ..	Green leaf 4,000 lb. plus superphosphate 112 lb. ..	21	1,700
Sugarcane.	Anakapalli ..	Cattle manure 5 tons plus green leaf 2,000 lb. plus super plus ammonium sulphate.	17	*
	Palur ..	Ammonium sulphate 100 lb. plus groundnt cake 1,000 lb.	40	*
		Ammonium sulphate 200 lb. plus groundnut cake 800 lb.	52	*
Plantain ..	Samalkot ..	Ammonium sulphate 2½ oz. plus potassium sulphate 2½ oz. plus super 3½ oz. per tree.	15	16 lb. per tree.
	Palur ..	Potassium sulphate 168 lb. plus groundnut cake 560 lb. plus super 224 lb. (Potassium sulphate was obtained from cane trash).	95	7,300 lb. of fruit per acre.
Cotton ..	Coimbatore ..	Cattle manure 15 cartloads	22	560 lb. kapas.
		Green manure ploughed in situ	16	560 lb. kapas.
		Ammonium sulphate 336 lb. plus superphosphate 336 lb.	46	560 lb. kapas.
		Ammonium sulphate 336 lb. plus potassium sulphate 100 lb. plus superphosphate 336 lb.	34	560 lb. kapas.

Crop	Locality	Manures recommended and the dosage per acre.	Percentage increase in yield over the control as a result of application.	Normal yield control), lb.
	Guntur and Nandyal.	Ammonium sulphate 224 lb. plus superphosphate 112 lb. plus cattle manure 5 cartloads.	22 and 16 ..	258 lb. kapas respectively.
	Koilpatti ..	Groundnut cake 250 lb. plus ammonium sulphate 112 lb. plus superphosphate 112 lb. plus cattle manure 3 tons.	30	560 lb. kapas.
Cholam ..	Guntur Hagari and Nandyal.	Ammonium sulphate 224 lb. plus superphosphate 112 lb. plus cattle manure 3 tons.	67, 72 and 55 respectively.	403 lb. 179 lb. and 445 lb. respectively.
	Koilpatti ..	Groundnut cake 500 lb. plus superphosphate 112 lb. plus cattle manure 2 tons plus cotton compost 1 ton.	266	500 lb.
Tenai ..	Hagari ..	Cattle manure 6,000 lb. (50 lb. nitrogen) ..	25	380 lb.
Groundnut.	Nandyal ..	Cattle manure 3 tons	28	1,360 lb.
Maize ..	Guntur ..	1. Cattle manure 5 cartloads plus bone meal 224 lb.	22	468 lb.
Maize ..		2. Cowpea ploughed in situ with 56 lb. P_2O_5 in	47	468 lb.
Variga ..		the form of superphosphate. Do. Do.	57	4 4 lb.
Tobacco ..	Guntur ..	Ammonium sulphate 224 lb. plus potassium sulphate 100 lb. plus super 224 lb. plus cattle manure 4 tons.	22	
Pepper ..	Taliparamba ..	Leaf mould 20 lb. plus fish guano ¼ lb. plus sodium nitrate or ammonium sulphate ¼ lb. plus super ¼ lb. plus lime ¼ lb. per vine.	37	5·7 Tolas per vine.
Coconut ..	Kasargode ..	Ammonium sulphate 3 lb. plus ash 20 lb. plus cattle manure 100 lb. per tree.	69	
Potato ..	Nanjanad ..	Groundnut cake 500 lb. plus ammonium sulphate 200 lb plus bone meal 350 lb. plus potassium sulphate 224 lb. plus concentrated superphosphate 336 lb.	15	542 maunds.

* The yield of control is not given in these experiments but the normal yield in Anakapalli is 45–50 tons and at Palur 30–40 tons per acre.

THE SAN JOSE SCALE

QUADRASPIDIOTUS PERNICIOSUS (Comst.) in the Nilgiris

By M. C. Cherian, B.A., B.Sc., D.I.C.,
Entomologist to the Government of Madras

The much dreaded San José Scale has made its appearance quite recently on apples in the Nilgiris. There is little doubt that the news of its occurrence will be received with consternation by one and all who have the well being of the fruit industry at heart. Like its compere the Cottony Cushion Scale—*Icerya purchasi* Mask., it has earned for itself an extremely bad reputation. Its capacity to inflict injury to fruit trees is unlimited. It infests apple, plum, peach, currant, cherry, pear, quince, citrus and other fruit trees and shrubs. It has a partiality for attacking plants belonging to the order *Rosaceae*.

Though originally a native of China, the insect was noted in 1877 in San José in California. From small beginnings it attained serious proportions and developed into a major pest by 1892. Most of the Federal States soon enacted their own inter-state protective plant quarantine regulations and established 'Inspection Services' to safeguard against the introduction of this unwanted pest. The insect at present enjoys a world-wide distribution being found in nearly all the fruit-growing regions. More recently it has gained a foothold in North India especially in the North-West Frontier, the Punjab and United Provinces and Kashmir where fruit trees are found affected.

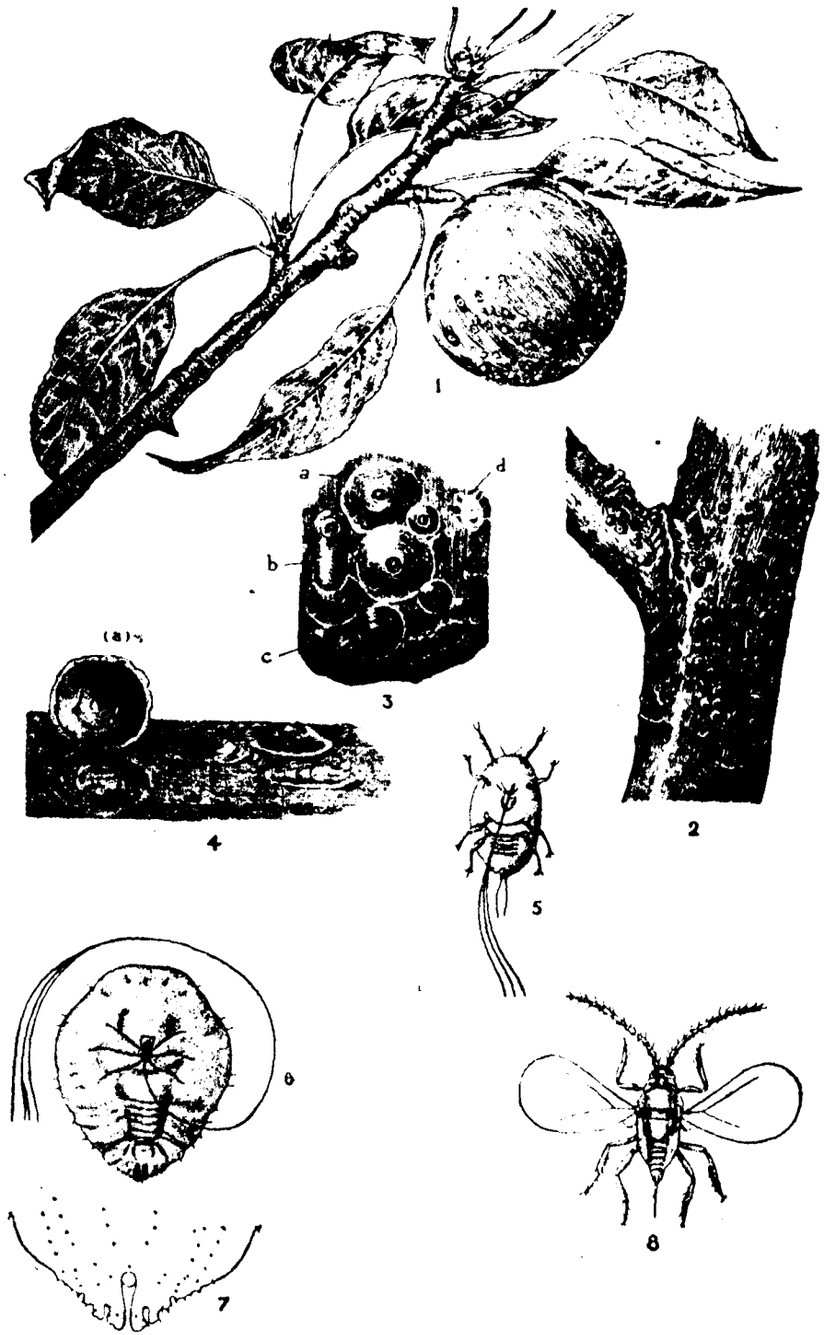
The control of San José by parasites and predators unlike in the case of the Cottony Cushion Scale has not shown much of promise. The use of potash fish oil soap, dormant sprays of diesel oil emulsion and lime sulphur is advocated on a field scale whereas fumigation with hydrocyanic acid gas is recommended for nursery stock.

The insect belongs to the group of armoured scales—*Diaspinae*. The scale of the female is round in shape, slightly convex and raised a little at the centre with a black pustule. It is about 1 mm. in diameter (about the size of a pin head). The male scale is smaller in size, more linear and oblong and about twice as long as broad. The adult female which is found fixed underneath the scaly covering is yellowish orange in colour and of the shape of a flattened seed. The young nymphs are capable of crawling about. The adult male is a tiny insect provided with a pair of wings.

The insect possesses remarkable powers of reproduction and develops a number of generations in a season. It has been estimated that a single female, under favourable circumstances, can give rise to as many as three thousand million progeny during the course of one year. When the infestation is severe, the scales occur in a mass overlapping one another covering the stems, branches, leaves and fruits. The affected trees are either killed outright or rendered unproductive. In the case of trees in bearing the fruits get badly scarred and spotted. The different stages of the pest are shown in the plate opposite.

One of the chief characteristic features by which the presence of this particular species can be recognised is the purple discolouration caused around the edge of the scale on the fruit. As regards the agency and distribution it is certain that the pest finds its way into new localities through imported fresh fruits, nursery stock, etc. Such being the case it is of paramount importance that imports of the kind noted above are properly scrutinised and fumigated at the port of entry before they are allowed in. Otherwise there is always the danger of the insect finding its way without our actually knowing it.

This note is meant as a warning to florists and fruit growers who are requested to be on the look out for the presence of the insect and intimate the fact to the Government Entomologist, Lawley Road P.O., who will be glad to render all the help.



THE SAN JOSE SCALE

(*Quadraspidiotus perniciosus* Comst.)

1. Infested apple twig with fruit. 2. Twig—closer view.
3. (*a*) Adult female scale, (*b*) Adult male scale, (*c*) Young scale, (*d*) Nymph—just hatched.
4. Scale lifted to show female. 5. Young nymph.
6. Female. 7. Pygidium of female. 8. Male.

Figs. 1 to 4. From *Farmers' Bull.*, No. 650, U. S. Dept. Agr.
Figs. 5 to 8. *Queensland Agr. J.*, Vol. 11, part 6.

Tomato *(Lycopersicum esculentum)*

Introduction.—Though the cultivation of tomato on a large scale is of recent origin, it has come to stay as one of the most important vegetable crops in South India. At present its cultivation is mainly confined to the neighbourhood of big towns. It is essentially a cold-season crop but thrives best on the hills during the hot weather and in the plains in all seasons except the summer. In Coimbatore district there are two main seasons for growing tomato. The first is from June to September and the second from November to February. Plantings done after January suffer considerably due to wilting.

Varieties.—There are a number of varieties which are not similar in their performance in different localities. Ponderosa gives large purple fruits, while Golden Queen is a very high yielding variety. Marglobe has good flavour and is reported to be wilt resistant. Bonny Best is an early bearing, vigorous crop. The varieties which have done well in Coimbatore are Bonny Best, Marglobe, Richmeat and Golden Queen.

Soil.—Tomato is not orthodox in its soil requirements though it does not stand badly drained and heavy clay soils. The best yields are obtained in light loamy soils of high fertility and good physical condition. Particular attention should, however, be paid to see that tomato is properly rotated and is not replanted in the same field in less than 3 to 4 years.

Nursery.—To provide good drainage, it is better to raise seedlings in raised beds of convenient sizes. The soil must be in good tilth and well manured with cattle manure. About 4 to 5 ounces of seed sown in an area of 2 cents will be sufficient to plant one acre. The seed is sprinkled over the beds and lightly covered and then hand-watered. Watering is done every morning and it is preferable that the beds are dry in the evening to prevent damping off disease. Excessive watering tends to produce tall and spindly seedlings. The seedlings will be ready for planting 35 to 40 days after sowing.

Preparatory cultivation.—It is necessary to bring the soil to fine tilth before taking up transplanting. As the seedlings are planted on the sides of ridges, a cultivator is worked to form ridges about 2 to 3 feet apart.

Manuring.—Tomato responds quickly and profitably to the use of manures and fertilizers. A basal dressing of about 15 to 25 cart-loads of farm-yard manure applied at the time of preparatory cultivation provides sufficient organic manure. As the crop requires

same design and size as the wooden boxes with a concave bottom to collect the drainage water on the sides are more suitable.

fertilizers with nitrogen in a readily available form, it is necessary to supplement the cattle manure with an application of nitrogenous and phosphatic manures. It is observed that an application of 800 lb. of groundnut-cake meal mixed with 200 lb. of ammonium phospate applied in two equal doses, one just *prior to transplanting* and the other at the time of earthing up, has proved beneficial to the crop. Too much of nitrogen induces rank vegetative growth causing retardation in the maturity of fruit.

Transplanting.—It is better that the transplanting is done in the afternoons and if possible in cloudy weather. The nursery has to be watered a few hours before lifting the seedlings. It is good to lift the seedlings with some soil sticking to the roots as it helps in the starting of the plants and the seedlings are transplanted immediately after they are lifted from the nursery giving a spacing of 1½ feet to 2 feet in the same row. The ' life ' irrigation is given about 3 to 4 days later and if any of the seedlings have failed to establish, the gaps are filled up.

After-cultivation.—The crop must be kept free from weeds to get maximum returns. Being a shallow-rooted crop, deep inter-cultivation should be avoided. Two to three weedings at intervals of a month are necessary to keep down the weeds. In the absence of rain, the crop requires irrigation once in 7 to 8 days. The crop is earthed up about 45 to 50 days after transplanting. It has been recorded that in Coimbatore staking and pruning are not necessary for raising a successful crop of tomato. Though it is a fact that pruning the laterals and staking the main shoot helps in the development of big sized uniform fruits, which ripen evenly due to the exposure to the sun, the gross yield is not higher than in the *untreated crop. In addition,* staking of tomato on field scale involves enormous expenditure which is not compensated by any additional yield. During the rainy season, however, care must be taken to see that the field is well drained, as water-logging causes heavy damage to the crop.

Picking.—The first picking of fruits can be made about two months after transplanting. During the first fortnight picking may be done once in 3 to 4 days; but afterwards daily or on alternate days. The picking season lasts for about 2½ to 3 *months.* Great care must be bestowed in the picking of fruits, as no other vegetable is so easily injured from careless handling as the tomato. If the market is near, tomatoes may be picked when they are ripe but before they become over-ripe and soft. For distant markets, tomatoes must be picked *in the turning stage, i.e., when* the tomatoes have changed colour to about half the length from the

blossom end. They attain the full colour in a day or two. If the transit is prolonged it is better that the tomatoes are harvested at the mature stage, when the tomatoes are fully mature but not have changed colour. The fruits must be picked free of the peduncle as its presence damages the fruit in changing over from basket to basket. The produce must be free from damaged or diseased fruits as their presence reduces the market value of the fruit. The tomatoes can be roughly graded into three grades mainly on size, viz., big, medium and small.

Yield.—There is considerable variation in the yield depending upon the season, land, etc. When conditions are favourable tomato yields up to 20,000 lb. per acre though the average is about 12,000 lb.

Pests and diseases.—The crop is comparatively free from any serious pests and diseases. In some seasons damage is caused to the crop by the appearance of the ' wilt ' disease caused by the fungus *Fusarium sp.*, which results in the sudden drying up and death of a number of plants in the field. The affected plants should be collected and burnt. The fruit sucking moth is another pest which causes damage to the mature fruits. Mosaic disease is also observed at times, but is never a serious problem.

Cost of cultivation.—The following represents roughly the economics of growing an acre of tomato under conditions such as those at Coimbatore :—

Pairs at Rs. 4, men at 14 annas and women at 7 annas per day.

	P.	M.	W.	Rs.	A.	P.
Preparatory cultivation—						
Ploughing thrice and forming ridges and channels.	7	10	8	40	4	0
Manures and manuring—						
Transporting and applying manure	1½	1½	13	13	0	0
Cost of manures		..		132	4	0
Irrigation—						
Fifteen irrigations on the whole—						
Guiding water at two men per irrigation.	..	30	..	26	4	0
Electricity charges at Rs. 2 per irrigation per acre.		..		30	0	0

Figs. 1 to 4. From *Farmers' Bull.*, No. 650, U. S. Dept. Agr.
Figs. 5 to 8. *Queensland Agr. J.*, Vol. 11, part 6.

same design and size as the wooden boxes with a concave bottom to collect the drainage water on the sides are more suitable.

	P.	M.	W.	Rs.	A.	P.
Seeds and sowing—						
Cost of raising nursery				15	0	0
Transplanting			12	5	4	0
Total ..				20	4	0
After-cultivation—						
Two weedings			50	21	14	0
Earthing up the plants			8 ..	7	0	0
Total ..				28	14	0
Harvesting—						
Picking fruits for three months			70	30	10	0
Lease amount of 1 acre of garden land ..				100	0	0
Total cost of cultivation per acre				321	8	0
Outturn per acre—						
Value of 12,000 lb. at Rs. 8 per 100 lb.				960	0	0
Total expenditure				421	8	0
Net profit per acre				538	8	0

This, however, is exclusive of marketing charges.

U. Narasinga Rao,
Fruit Specialist, Madras.

GOVT. PRESS, MADRAS.

Figs. 1 to 4. From *Farmers' Bull.*, No. 650, U. S. Dept. Agr.
Figs. 5 to 8. *Queensland Agr. J.*, Vol. 11, part 6.

Vegetable Culture in Boxes

New Technique Outlined for City Dwellers who Lack Suitable Backyards

Town and city dwellers who have the use of suitable backyards can grow vegetables in them. But there must be innumerable urban citizens who do not have the use of a backyard, suitable or otherwise. However, these persons need not be excluded from home vegetable gardening on this account. In recent years a new art in horticulture has sprung up, that of growing vegetables in handy boxes or pots which can be kept on window-sills and balconies. Successful crops can be harvested.

' Pot ' culture in horticulture refers to the cultivation of plants in pots or boxes. To persons competing in horticultural exhibitions and shows, the principles of this method are familiar at least in so far as cultivation of annual flower plants are concerned. Vegetable culture in pots is really nothing more than an extension of the application of the same principles. Pot culture of vegetables may appear to be more difficult than growing on a plot of ground in open; in actual practice there is no limit to the standard of good cultivation that can be achieved in the former method.

Window boxes.—Because of the conditions which prevail inside a house, window boxes must be made comparatively deep. The boxes must contain a larger quantity of soil than is commonly necessary for the growth of plants in pots in the open, so that the adverse conditions may in part be counteracted. Boxes intended for window vegetable gardens should therefore be made at least one foot in depth, rather broad, and of a length to conform to the window opening or for a safe seating on the sills and balconies.

Though wooden boxes are in use, their prohibitive cost, their tendency to warp in the sun, and the difficulty of keeping them free of fungal spores without either painting (which is harmful to the plants) or scrubbing (which is damaging to the wood) makes them rather unpopular. Instead, earthenware pots made of the same design and size as the wooden boxes with a concave bottom to collect the drainage water on the sides are more suitable.

Soils for the boxes.—The soil should be rich garden loam or a compost consisting of rotten leaf mould and cattle manure thoroughly mixed together and sifted through a screen with at least a half-inch mesh.

Before filling the box a layer of broken pots (crocks) or coarse gravel should be placed over the bottom end of the box to the depth of one inch. If the box is made airtight, holes should be provided in the bottom, so that any excess of moisture which comes from watering the plants may escape from the bottom. After placing this drainage material in the bottom of the box, fill it up to within an inch of the top with the prepared soil.

Planting and Aftercare.—Among the numerous vegetable crops commonly grown, there are some which are usually small seeded and so require transplanting to provide adequate spacing between the plants for their optimum growth. There are others which have larger seeds that can be straightaway sown *in situ* to provide the requisite spacing even at the outset. It is customary to raise the seedlings of the former in shallow pans; when they have grown big enough to be handled with ease, they are picked out and planted in the boxes. The latter need no such precaution and their seeds are grown directly into the boxes. The spacing will depend on the natural vigour and habit of the plant.

Vegetables such as bendhi and brinjal have to be spaced at a minimum of one foot between the plants, while tomatoes can be planted at nine inch intervals. The boxes with the plants should be exposed to light and if possible to the sun for at least four hours every day. This is very necessary to avoid giving the plant a check at any period of its growth.

Watering of the boxes should be done with special care. While the soils in the boxes should never be allowed to go dry, it is equally necessary to avoid keeping the boxes in a soaked condition.

Normally, the made up soil in the box will provide all the food that is required by the plants during the course of their life. But occasionally when the plants do not make satisfactory progress, applications of dilute liquid manure or a weak solution of ammonium sulphate helps somewhat to hasten growth. The boxes should be kept free of weeds which may spring up from seeds brought in with the compost. Frequent stirring of the surface

soil helps in breaking the crust and permits the water added to the box to permeate the soil and the excess to drain away.

The plants should be syringed with a weak solution of potassium permanganate, or Bordeaux Mixture to keep them free from wilt and other diseases which are prone to appear under the peculiar conditions of the dwelling house.

When the crops are harvested, the boxes should be emptied of the soil, scrubbed well and treated with a disinfectant solution before being used again. The thrown out soil should not normally be used again. In raising any particular vegetable in boxes, its seasonal preferences should not be overlooked. By a careful selection of the vegetables to be grown in each month or season, box-culture can afford to the grower a succession of home-grown vegetables almost throughout the year.

General precautions.—Here are some causes which often result in failure of vegetable plants in boxes. The home gardener should never lose sight of them :

1. *Sowing or planting too thickly.*—The soil in a box is after all limited in quantity and cannot possibly nurture an unrestricted number of plants. There is moreover the natural habit and vigour of the plant to be taken into account. A cramped plant can neither grow well nor crop well.

2. *Permitting seedlings to become drawn.*—Plants growing inside a house under covered conditions have a natural tendency to become spindly and drawn out in their search for light and sun. This can be reduced to an extent by placing the boxes in the sunniest side of the house for as long a period in the day as possible.

3. *Transplanting too late.*—Box plants should not become unwieldy. For successful building up of sturdy and stocky plants, timely transplanting of the seedlings from seedbeds is essential. Delay will result in the planting of overgrown plants which are difficult to train to any desired shape or size.

4. *Damage to the root system.*—A damaged root system either at the time of transplanting or in hoeing the soil in the box, spells disaster to the development of the plant. Box culture is an intense form of cultivation where there is fierce competition between the plants. Unless a plant is set along in its course of growth with its roots intact, it cannot develop with new roots.

5. *Disease.*—The humidity of the air inside a room or within a house is generally higher than in the open. This is further accentuated by the daily watering of the boxes and the transpiration of the plants. In such an atmosphere the onset of fungal diseases is a common occurrence. Their control is generally a tedious task and the losses sustained are too serious to the grower who deals at best with only a limited number of plants. Prevention and forestalling of the diseases is by far the most practical means of saving the plants. This can easily be accomplished by a weekly spray of potassium permanganate solution or Bordeaux mixture done with a syringe.

In the present food crisis vegetable cultivation in boxes has a special role to play. for it enables every individual citizen to contribute his share, however small, to the drive towards self-sufficiency. The home box gardener also gets the thrill of creating new life and watching it develop. Finally, to the children at home there can be no better object lesson than the unfolding of plant life from the seemingly insignificant seed.

ISSUED BY THE DEPARTMENT OF INFORMATION AND PUBLICITY,
GOVERNMENT OF MADRAS

GOVT. PRESS, MADRAS.